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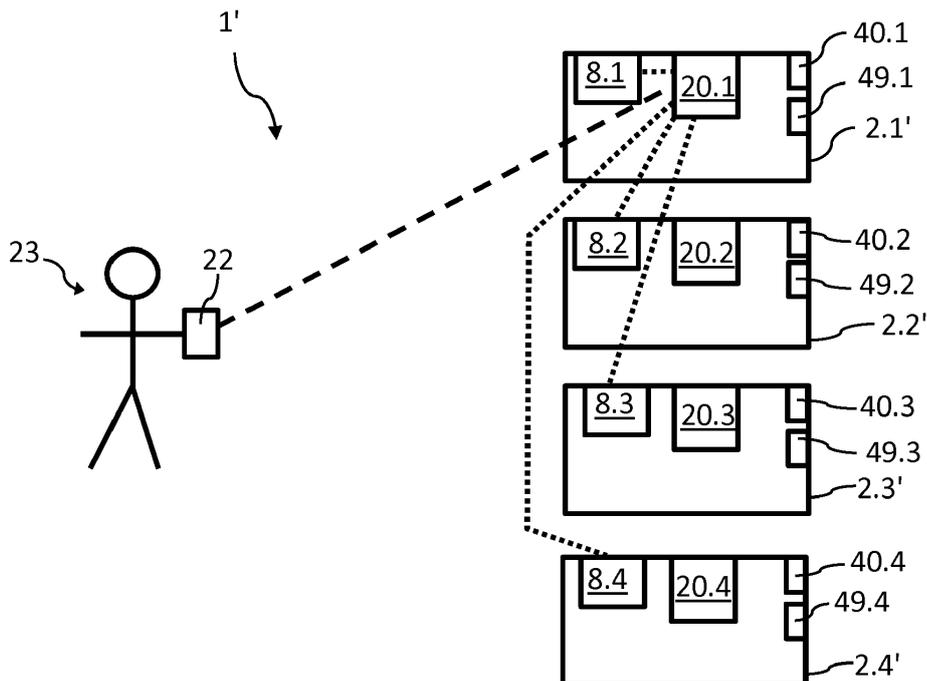
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Claims 16-19 are deemed to be abandoned due to non-payment of the claims fees (Rule 45(3) EPC).

(54) **BALL GAME TRAINING SYSTEM**

(57) The invention provides a ball game training system based on a plurality of wall arrangements comprising walls and support structures. The wall structures can be positioned in a freestanding manner, thanks to support structures. The walls comprise a tactile front surface and electronic equipment for detecting the position of an im-

part of a ball on the wall. The walls further comprise a grid of LED strips, which form a segmented font display, for example a 7-segment font or display. The training system is configured to be run by a user via a portable computing device, such as a smart phone or computer pad.



**Figure 4 B**

## Description

### Technical Field

[0001] The present invention relates to a training system for ball games, the system comprising a wall structure comprising a plurality of targets, wherein any one of said targets can be highlighted or activated for defining a next target to be hit by a player. The present invention further relates to said wall structure as such, to a wall arrangement comprising the wall structure and a support structure, to methods for operating the training system and to methods of conducting exercising using the training system of the invention.

### Background Art and Problems Solved by the Invention

[0002] Generally, the present invention seeks to provide a wall structure suitable for conducting exercises in ball sports. The wall structure comprises a plurality of targets, and a particular exercise generally comprises the steps of informing a player about a particular target on the wall structure to be hit next as part of an exercise, and determining the impact of the ball on the wall structure. The wall structure preferably comprises means for determining if the targeted impact area has been hit, and ideally means for assessing a player on the basis of hits on the targeted impact area or on the closeness of a ball impact to the targeted impact area.

[0003] The present invention seeks to provide a wall structure that enables an automated assessment of a player conducting an exercise using a training system based on a wall structure containing targets.

[0004] The present invention seeks to provide a wall structure that enables conducting a plurality of different exercising, preferably exercising involving a plurality of wall structures.

[0005] The invention seeks to provide a wall structure that is sufficiently rigid to withstand the impact of balls during an exercise without damage and substantially without displacement as a result of a ball impact. However, the invention also seeks to provide a wall structure that is displaceable. Accordingly, it is an objective of the invention to provide a wall structure that is sufficiently light for allowing displacement by human staff, preferably without motorized transport equipment, and which further can be positioned fixedly or rigidly at any selected position on a playing ground determined by a user of the system, for a determined manner of time, in particular for the time of an exercise. The invention also seeks to provide a wall structured the position of which on a ground can be modulated, for example, which is height adjustable.

[0006] It is also an objective of the invention to provide a wall structure for training a ball game, which wall structure is suitable for outdoor use. The invention seeks to provide a wall structure that can be positioned on the

ground of a sports center.

[0007] The invention also seeks to provide a training system comprising a plurality of wall structures, which can be positioned in any manner as desired by a user of the system, so as to provide different types of exercises, and to provide the possibility of defining exercises by the user.

[0008] The invention also seeks to provide a training system enabling a user to define own exercises in a convenient manner, preferably making use of readily available electronic equipment. The invention seeks to provide a training system comprising wall structures that can be operated and/or configured through portable equipment, such as computer pads, smartphones, portable computers (notebooks) and the like. The invention also seeks to provide a training system that can be operated and/or configured by way of an application that can be downloaded on a touchscreen-based pad or smartphone.

[0009] The invention also seeks to provide a training system that allows analysis of a player's performance and statistics related thereto, and which allows monitoring progress of a player using the wall structure for training.

[0010] GB 2 424 592 discloses a ball target apparatus, which comprises a plurality of planar elements arranged in a generally circular array, each planar element having at least one target area. Each planar element is connected at each of its extremities to another planar element, in such a manner that the planar elements stabilize the entire apparatus. Due to this constraint, it is not possible to use a single planar element of this device alone, independently of the other elements, and it is not possible to change the spatial arrangement of the planar elements for defining own exercises, for example.

[0011] US 8,506,370 is similar to GB 2 424 592 in that wall structures comprising target areas are arranged and connected to form a hexagon, and wherein a player positioned within the hexagon can conduct exercises by trying to hit a target area of the wall structure. This document does not provide a possibility of exercises based on a plurality of freestanding wall structures. The present invention seeks to provide solutions for identifying individual targets that are to be hit by a player and, possibly to indicate a message related to the success of a player.

[0012] The present invention addresses the problems depicted above.

### Summary of the Invention

[0013] In an aspect, the invention provides a ball game training system comprising a wall structure comprising a front side on which a plurality of targets can be defined and/or indicated.

[0014] In an aspect, the invention provides a ball game training system comprising a wall structure comprising a digital and/or segmented display for defining and/or highlighting target on said wall structure.

**[0015]** In an aspect, the invention provides a ball game training system comprising a plurality of wall arrangements, each wall arrangement comprising a wall structure and a support structure. Preferably, the support structure allows an individual wall arrangement to be positioned in a free-standing manner on a sports ground.

**[0016]** In an aspect, the invention provides a ball game training system comprising a wall structure comprising a control unit configured to receive data related to the position of the impact of a ball on a front surface of the wall structure, and configured to highlight a target on said front surface. Preferably, said training system comprises software and/or an application that can be run of a portable device, such as a smartphone, and wherein said software and/or application is configured to use a wireless communication module of said portable device to communicate with the control unit of said wall structure.

**[0017]** In an aspect, the invention provides a ball game training system comprising a wall arrangement comprising a layered wall structure, said wall structure comprising a wall a front side on which a plurality of targets can be defined, wherein said front side of said wall structure is covered by a protective impact layer comprising a material that enables the conduction of sound waves across said protective impact layer, said wall structure further comprising a support layer with which said protective impact layer in contact, wherein said wall structure comprises at least one sound sensor arranged so as to sense sound produced from an impact of a ball on said protective impact layer, and wherein said training system further comprises a control unit receiving data from said sound sensor, said control unit being configured to determine the impact point on said protective impact layer of a ball hitting said impact layer from the data produced by said sound sensors.

**[0018]** In an aspect, the invention provides a method for training a player of a ball game, the method comprising the step of running an exercise of the training system of the invention with the player.

**[0019]** In an aspect, the invention provides a method for assessing a player of a ball game, the method comprising the step of running an exercise of the training system of the invention with the player and assessing the performance of the player with the training system.

**[0020]** In further aspects, the invention provides components of the training system of the invention. In particular, the invention provides a wall arrangement as defined and/or described with reference to embodiments in this specification. The invention also provides a wall structure as defined and/or described with reference to embodiments in this specification.

**[0021]** Further aspects and embodiments are provided in the appended claims, and in the detailed description of preferred embodiments herein below.

### **Brief Description of the Drawings**

**[0022]**

**Figures 1 A and 1 B** show a perspective assembled and an exploded views, respectively, of a wall arrangement in accordance with an embodiment of the present invention.

**Figure 2 A** schematically shows a front view to a wall arrangement in accordance with an embodiment of the invention.

**Figure 2 B** is a photograph showing a wall arrangement of an embodiment of the invention in which a target defined by LED strips is highlighted.

**Figure 2C** schematically shows a wall of an embodiment of the present invention, in which LED strips are replaced by an array of individual or isolated LEDs.

**Figure 3** is a photograph showing a perspective view of a wall arrangement of the embodiment shown in Figure 2B, illustrating the use of LED strips as a display on the wall structure of an embodiment of the invention.

**Figures 4 A and B** schematically shows the operation of electronic components of ball game training systems in accordance with embodiments of the invention.

**Figures 5 A, B, and C** illustrate different exercises that can be performed with the ball game training system of the invention.

### **Detailed Description of the Preferred Embodiments**

**[0023]** The present invention concerns a ball game training system comprising a wall arrangement. The system of the invention may be adapted and/or used with respect to all types of ball games including puck games. Exemplary ball games encompassed by the invention are football, soccer, American football, rugby, handball, basketball, volleyball, tennis, squash, table tennis, badminton, ice and field hockey, for example. The ball games include racket sports. The invention will be illustrated and described herein below by way of the exemplary embodiments shown in the figures.

**[0024]** **Figure 1 A** shows a wall arrangement 2 of a playing system 1 of a preferred embodiment of the invention. The wall arrangement 2 comprises a board-like wall structure or simply wall 3 and a support 11, which allows placing and stabilizing the wall 3 on the ground. The wall 3 is of a generally rectangular shape, having two parallel top and bottom sides 17a and 17b, as well as two substantially parallel, left and right sides 18a and 18b. In the embodiment shown, the support 11 comprises two separate, left and right support structures 11a and 11b. The support structures 11a and 11b are fixed laterally to the wall 3, in particular at the left and right sides

18a and 18b of the wall 3. The support 11 comprises a weight element 16, which contributes to the temporarily stable, yet displaceable, placing of the wall 3 on the ground. The construction of the wall 3 and the support 11, as well as the height adjustable attachment of the wall 3 with respect to the support 11 will be described in more detail with respect to Fig. 1B.

**[0025]** The exploded view of **Figure 1 B** shows main structural components, except electronic and electric components, of the wall arrangement 2 of the invention. The wall structure 3 comprises a plurality of generally board-like or flat layers 4, 6, 24, 26-28 and attachment means 29, for clamping the flat, board-like structures having substantially an identical contour in a sandwich-like manner together, so as to form an overall flat wall structure 3 comprising two opposing sides, a front side 12 and a rear side 13.

**[0026]** The wall arrangement further comprises elements that are placed in or integrated in one or more of said board-like structures, such as the LED strips 5, sensors, cables and electronic components (not shown), and a frame-like joint layer 25, which creates a central empty space in which cables can be collected, and which allows absorption of impacts. The layers are arranged in a frame structure 30 having an inner contour matching the outer contour of the board like structures, such as to laterally house and/or surround the board-like structures. The outer contour of the board-like structures thus preferably has an identical contour and an nearly identical surface (slightly smaller to allow convenient placement within frame 30) as the frame 30.

**[0027]** It is noted that the attachment means 29 are preferably screws, gripping in inner threadings provided in the frame structure 30, thereby clamping the board-like structures to the frame 30.

**[0028]** The rectangular frame 30 delimits the wall structures 30 laterally, and thus provides the top and bottom and left and right sides 17a, 17b, 18a, 18b, of the assembled wall 3 as shown in Fig. 1A. The breadth of the sides 17a, 17b, 18a, 18b of the frame 30 corresponds to the breadth of the entire wall 3. The breadth of the frame 30 is sufficiently large to accommodate the board-like layers 4, 6, 24, 26-28 and further components of the wall 3, including electronic components.

**[0029]** The several layers of the wall structure 3 are now discussed in the order in which they appear in the assembled wall structure from the front side 12 to the rear side 13. The front side 12 of the wall structure comprises a protective impact layer 4. The impact layer 4 covers and/or allows or provides visual presentation of all possible targets 9 of the wall structure 3. In Fig. 1A, the targets are not visible, and in Fig. 1B they are visible indirectly, by way of the position of the LED grid 5 and the grooves 38 in the support layer 6, which will be described below.

**[0030]** In the wall of the present invention the targets may not be visible from the outside, unless a particular target is highlighted. In other embodiments, targets are

visible even in the absence of highlighting, such that the positions of targets on the wall 3 can be comprehended by a player.

**[0031]** In the embodiments shown in the figures, a target corresponds to a grid area as defined by a grid 5 of LED strips. Generally, a grid area 9 corresponds to a target. The target may thus be a target area. In other embodiments, the invention envisages targets 9 that are not specifically defined as an area. For example, a target could be a cross or could have the design of a gun-sight. A target may thus define a point or area to be hit by a ball, wherein the goal is to have an impact as close as possible to the point or to the center of the area.

**[0032]** As will be described elsewhere in this specification, a particular target can also be defined by highlighting a combination of two or even four grid or target areas.

**[0033]** It is noted that reference numeral 9 is used to refer to any individual target or to refer to a plurality of individual targets of the wall 3, such as all targets of a wall arrangement 3. In Fig. 2A, individual targets are specifically indicated with reference numerals 9a-9d and 10a-10d. In Fig. 5A, individual targets as defined by grid 5 of LED are specifically indicated with reference numerals 9a and 9e.

**[0034]** During exercising with a ball game, the balls impact on the impact layer 4, which is why impact layer is preferably resistant to powerful impacts from balls, as they may occur in football, tennis, field- and ice hockey and the like. In addition, the impact layer 4 preferably comprises or consists essentially of a material that is conductive to sound waves. In accordance with the present invention, the position of an impact of a ball on the wall structure 3 is determined by way of sound sensors, as will be described in more detail elsewhere in this specification. For this reason, the material from which the impact layer 4 is made preferably allows conduction of sound waves. In other words, sound waves should be capable of being propagated across the material from which the impact layer 4 is made.

**[0035]** The impact layer 4 is preferably made from a transparent or translucent material and is thus indeed at least partially transparent to light. As will be described in more detail below, signalling and/or displaying light sources, in particular LED strips, are preferably provided in the layer following and/or covered by the impact layer and are used to indicate the next target to an exercising player. Light signals are provided across the impact layer 4, which is why the latter has to be at least partially transmissible to light. In a preferred embodiment, the training system of the invention comprises a rigid support layer 6 comprising grooves 6 in which LED strips 5 are provided, and/or wherein said protective impact layer 4 is transparent or translucent to light produced by LEDs of said led strips 4.

**[0036]** In a preferred embodiment, the impact layer is preferably made from a shock-resistant polyethylene material.

**[0037]** The impact layer 4 is adjacent to and in front of the rigid support layer 6. The rigid support layer 6 comprises openings 37 and/or grooves 38, and is arranged to house the light sources and/or sound sensors. In particular, LED strips, LED light or other light sources are arranged in grooves 38 and sound sensors in openings 37 of the support layer 6. Since these electronic components are provided in recesses of the support layer 6, and since the support layer 6 is covered on the front side by the impact layer 4, the mechanical or kinetic forces of ball impacts or shocks are not transmitted to these electronic components and the latter are thus protected from mechanical damage. The support layer 6 may be made from wood or, more preferably, from injected plastic.

**[0038]** As can be seen in Fig. 1B, LED strips are joined to form a grid 5. Preferably, the LED strips form squares, the grid 5 thus being composed of squares, in particular two or more rows of squares. The support layer 6 comprises thus grooves 38 matching the form of the grid 5 of the LED strips, such that the entire grid 5 can be placed in the recesses formed by the grooves 38. The grooves 38 thus have also the form of a grid corresponding to the grid 5 formed by the LED strips. At some positions in the grid of grooves in the support layer, end-to-end holes are provided (not shown), through which electric cables from the LED strips are guided. The cables are generally guided from the sensors and/or LED strips towards the more rear parts of the wall arrangements, where electronic and/or electric components are housed.

**[0039]** The support layer 6 comprises end-to-end holes 37, in which sound sensors are housed and the cables which connect the sensors to the local circuit card assembly and microcontroller 8 (Fig. 4A and 4B). In the embodiment shown in Fig. 1B, a hole 37 is provided in the center of each grid area 9, such that each grid area 9 comprises its own sound sensor. In this embodiment, the target in which the impact occurred can be determined as being the target of the grid area the sound sensor of which was first to sense sound.

**[0040]** In another embodiment, the entire wall structure comprises less than one sound sensor per target or target area 9, for example one sensor per two or three targets, and preferably only one sound sensor for all targets 9. A device comprising a single sensor requires a calibration and/or access to a database comprising reference signals such that, by comparison to a reference signal, the point of impact can be determined by algorithm.

**[0041]** In a preferred embodiment, the entire wall structure comprises more than one, preferably 2-5 sound sensors. Preferably, the wall structure comprises only four sound sensors. In this case, the sensors are preferably positioned in the four corners of the wall structure. In these latter embodiments, the position of an impact is determined by calculation on the basis of the arrival time of a sound signal at each of the sound sensors. An algorithm based on this type of impact position determination will allow more accurate determination of impact. For example, it can then be taken into account if a particular

target was hit in or close to the center or at the border defining a target area 9. In particular, the algorithm allows determining the exact position of the impact of a ball on the wall structure. For example EP 0474232 discloses the setting for determining contact or impact using a plurality of sound sensors.

**[0042]** The implication of the above is that the resolution achieved with respect to the determination of the impact position is much higher than the resolution that may be suggested by the grid of targets 9 on the wall structure. For example, the position of a ball impact on the two dimensional impact surface provided by the front surface 12 of the wall 3 is preferably determined with an accuracy of +/- 5 cm, preferably +/- 3 cm, and most preferably +/- 1 cm.

**[0043]** On the other hand, the grid 5 of LED strips may define targets or grid areas having lateral side lengths of 15 cm-80 cm, preferably 20 cm-70 cm, more preferably 25 cm-60 cm, most preferably 30-50 cm. These lengths thus define the sides of rectangles, preferably squares, defining a target 9.

**[0044]** On the rear side of the support layer 6, a rigidifying board 24 is preferably provided. The rigidifying board 24 has the purpose of providing rigidity to the wall structure 3. In particular, the rigidifying board 24 has the purpose of counteracting and/or preventing flexion of the wall structure along an axis that is perpendicular to the front and rear surfaces of the wall structure 3, in particular as a consequence of a ball impact. In order to provide the required rigidity, the rigidifying board 24 has preferably a thickness of 0.5 to 10 cm, preferably 0.8-6 cm, more preferably 1.0-4.0 cm, for example 1.0-3.0 cm.

**[0045]** As has been specified in the introduction, the wall arrangement 2 of the present invention is preferably displaceable and sufficiently light to be carried by two persons. This is preferred so as to enable the performance of different exercise types using the same wall structures. It is thus preferred that the rigidifying board, which provides an important thickness to the entire wall structure 3, is comparatively light and/or has a low density.

**[0046]** Preferably, the density of the rigidifying board is less than or equal to ( $\leq$ ) 400 kg/m<sup>3</sup>, more preferably  $\leq$  300 kg/m<sup>3</sup>, even more preferably  $\leq$  200 kg/m<sup>3</sup>, and most preferably  $\leq$  150 kg/m<sup>3</sup>.

**[0047]** In a preferred embodiment, the density of the rigidifying board 24 is less than or equal to ( $\leq$ ) 150 kg/m<sup>3</sup>, more preferably  $\leq$  100 kg/m<sup>3</sup>, even more preferably  $\leq$  80 kg/m<sup>3</sup>, and most preferably  $\leq$  70 kg/m<sup>3</sup>.

**[0048]** In an embodiment, the indicative surfacic mass of the rigidifying board is  $\leq$  15.0 kg/m<sup>2</sup>, preferably  $\leq$  10.0 kg/m<sup>2</sup>, more preferably  $\leq$  7.5 kg/m<sup>2</sup>, and most preferably  $\leq$  6.5 kg/m<sup>2</sup>.

**[0049]** In a preferred embodiment, the rigidifying board 24 has a compressive strength of greater than or equal to ( $\geq$ ) 0.5 Mpa, preferably  $\geq$  0.7 Mpa, more preferably  $\geq$  0.8 Mpa, even more preferably  $\geq$  1.0 Mpa, and most preferably  $\geq$  1.2 Mpa. All reference to the compressive strength in this specification is preferably determined at

20°C by the ISO 844:2014 method. This also applies to other parameters covered by ISO 844.

**[0050]** In a more preferred embodiment, the rigidifying board 24 has a density of  $\leq 200 \text{ kg/m}^3$  and a compressive strength of  $\geq 0.5 \text{ Mpa}$ , preferably a density of  $\leq 150 \text{ kg/m}^3$  and a compressive strength of  $\geq 0.7 \text{ Mpa}$ , more preferably a density of  $\leq 100 \text{ kg/m}^3$  and a compressive strength of  $\geq 0.8 \text{ Mpa}$ , and most preferably a density of  $\leq 80 \text{ kg/m}^3$  and a compressive strength of  $\geq 1.0 \text{ Mpa}$ .

**[0051]** In an embodiment, the rigidifying board 24 has an indicative surfacic mass of  $\leq 15.0 \text{ kg/m}^2$  and a compressive strength of  $\geq 0.5 \text{ Mpa}$ , preferably an indicative surfacic mass of  $\leq 10.0 \text{ kg/m}^2$  and a compressive strength of  $\geq 0.8 \text{ Mpa}$ , more preferably an indicative surfacic mass of  $\leq 7.5 \text{ kg/m}^2$  and a compressive strength of  $\leq 1.0 \text{ Mpa}$ , and most preferably an indicative surfacic mass of  $\leq 6.5 \text{ kg/m}^2$  and a compressive strength of  $\geq 1.1 \text{ Mpa}$ .

**[0052]** In an embodiment, the rigidifying board comprises and/or consists essentially of a rigid cellular plastic. The rigid cellular plastic may comprise top and bottom layers that cover the cells of the cellular plastic. In a preferred embodiment, rigid cellular plastic comprises honeycomb structured cells. The rigid cellular plastic preferably has the thickness as indicated above for the rigidifying board 24.

**[0053]** In an embodiment, the rigidifying board 24 comprises a plurality of juxtaposed plastic tubes oriented in a perpendicular orientation with respect to a surface of said rigidifying board 24, and/or with respect to the front and /rear surfaces 12, 13 of the wall structure 3. Said plastic tubes preferably have a honeycomb structure and/or form (hexagonal cross section), but may also have circular and/or polygonal cross-sections in general.

**[0054]** In an embodiment, the rigidifying board 24 comprises a plurality of holes 31, in which the cables connecting the LED strips and/or the sensors with the data processing electronic equipment are guided.

**[0055]** Adjacent to and behind the rigidifying board 24, the wall structure 3 shown in Fig. 1 B preferably comprises a jointure 25, which is capable of contributing to the absorption of the impact shock. The jointure 25 preferably is realized in the form of a frame, which is provided along the border of the preceding board. The jointure 25 thus comprises a large central hole. The central hole makes up almost the entire surface of the surface surrounded by the frame. In other words, the jointure 25 comprises not much more than lateral space-holders that create an empty space inside the assembled wall structure. In this manner, electric connections from the LED strips and sound sensors guided through the holes 31 of the rigidifying board 24, are bundled in the empty space created by jointure 25. The jointure 25 is preferably made from an elastic material, in particular an elastomer, such as rubber.

**[0056]** Adjacent to and behind the jointure layer 25, the wall structure 3 may comprise a further rigidifying board 26. The second rigidifying board 26 preferably has the

same properties as the first rigidifying board 24. The wall structure 3 of the invention thus preferably comprises a first and a second rigidifying boards 24, 26, separated by one or more layers, preferably separated by the jointure 25. Rigidifying boards 24, 26 may also be referred to as front and rear rigidifying boards 24, 26, respectively.

**[0057]** Since the properties (density, compressive strength) of the second rigidifying board 26 are preferably the same as those of the first rigidifying board 24, they are not repeated any more. It is noted that the second rigidifying board is preferably made from the same material as the first rigidifying board. However, the second rigidifying board is preferably a bit thinner than the first rigidifying board. For example, the second rigidifying board 26 may have a thickness of 0.5 to 5, more preferably 0.9 to 3 cm, and most preferably 1.0 to 2.5 cm.

**[0058]** In the embodiment shown in Fig. 1B, a difference between the first and the second rigidifying board 24 and 26 is that the second rigidifying board 26 (the one closer to the rear side of the wall structure) comprises a single hole 32. The hole 32 is comparatively larger than the plurality of holes 31 provided in the first rigidifying board 24 and contains the bundled electric lines that are collected in the jointure layer 25.

**[0059]** The wall structure 3 comprises a layer 26 in which electronic components are provided, such as, for example, local circuit card assembly, the microcontroller 8 (not shown in Figs 1A and 1B), and, in some embodiments, a control unit 20. In an embodiment, This layer may be referred to as the electronics harboring layer 27 or filling layer 27 (to be filled with electronic equipment). This layer may be provided on the rear side of the second rigidifying board 26, or on the rear side of jointure 25, if the second rigidifying board 26 is absent. Preferably layer 27 is close to the rear end of the wall 3, for example the last layer before the back or cover layer 28.

**[0060]** Layer 27 may comprise a plastic board made from injected plastic material, for example. The plastic board 27 comprises openings, holes and recesses in which said electronic equipment 8, 20 is placed.

**[0061]** In an embodiment, a single board is used instead of the two separate boards 26 and 27. For example, the rigidifying board 26 can be entirely omitted.

**[0062]** Adjacent to and on the rear side of the electronics harboring layer 27, the wall structure 3 comprises a cover sheet or board 28, which may be made from plastic or metal, and allowing to close the wall structure 3 on the rear side. The layers 4, 6, 24, 25, 26, 27, and 28 preferably comprise holes along the lateral boarders, through which screws 29 are guided, fixing the layers inside the frame 30.

**[0063]** Besides the wall structure 3, the wall arrangement 2 comprises a support structure 11, to which the wall 3 can be vertically attached. The purpose of the support structure 11 is to attach the wall 3 so as to stabilize the wall 3 on the ground, for example on an exercising or sports ground.

**[0064]** In an embodiment, the wall arrangement 2 com-

prises a support structure 11 for stabilizing the wall structure 3 on the ground, said support structure 11 being attached laterally or at the rear side 13 on said wall structure 3 and/or extending away from the rear side 13 of said wall structure 3.

**[0065]** In a preferred embodiment, the support structure 11 is displaceable together with the wall 3. The wall arrangement may comprise a single support structure 11, which may, for example, be provided centrally at the rear side of the wall structure 3. Preferably, however, the wall arrangement 2 comprises two support structures 11a and 11b, the two support structures forming the support 11 of the wall 3. The two support structures may be connected laterally, on the left and right sides, to the wall arrangement, or they may both be provided on the rear side of the wall arrangement, for example.

**[0066]** Preferably, the wall 3 may be connected at the frame 30 to the wall structures 11a and 11b.

**[0067]** Each support structure 11, 11a and 11b preferably has a substantially triangular outline or contour. The support structure may be in the form of a triangular board. In a preferred embodiment, however, the support structures 11a and 11b are struts arrangements 14a-14c, in which each support structure comprises at least three struts 14a-14c connected at their ends so as to form said triangular strut arrangement. In this specification, the strut arrangement 14a-14c is described with respect to the right support structure 11b shown in Fig. 1B. The left support structure 11a has a substantially identical or analog structure compared to the right support structure 11b. For example, support structures 11a and 11b are mirror symmetrical.

**[0068]** In an embodiment, the training system of the invention comprises one or more a support structures 11, 11a, 11b, wherein each of said support structures 11 comprises a plurality of struts 14a-14c, said plurality of struts comprising a vertical or main strut 14a at which said wall structure is fixed and a horizontal strut 14b extending from the bottom end of the vertical strut 14a horizontally away from a rear side of the along a ground on which the wall structure is placed.

**[0069]** Each support structure 11, 11a and 11b preferably comprises a vertical strut 14a, which provides a point of attachment of the wall 3. At the bottom end of the vertical strut 14a, a horizontal strut 14b preferably extends in the rear direction, with respect to the front side 12 of the wall 3. The horizontal strut 14b thus preferably extends in parallel to the ground on which the wall arrangement 2 is positioned. Furthermore, the horizontal strut 14b provides the contact of the support structure with the ground, or at least part of the horizontal strut 14b is intended to be in contact with the ground. A stabilizing strut 14c extends from the rear extremity of the horizontal strut 14b to the top extremity of the vertical strut 14a, thereby closing the triangle formed by the struts 14a-14c. The triangle 14a-14c is preferably a right angle triangle. The invention also envisages that strut 14c extends from the rear extremity of the horizontal strut 14b to below the top

extremity of the vertical strut 14a, for example to about this center of the vertical strut 14a, without departing from the scope of the concept of the present invention.

**[0070]** In another embodiment, the support structure 11 does not have a triangular form. In an embodiment, the support structure comprises the form of an L, comprising essentially struts 14a and 14b. In an embodiment, a stabilizing strut 14c may be connected to a position close to the center of either one or both of horizontal strut 14b and vertical strut 14a. For example, the support structure 11, 11 a and 11b may look like a skipped letter "A", wherein the sides of the "A" are the horizontal and vertical struts, 14a and 14b.

**[0071]** In an embodiment, the angle of the wall 3 and/or of the planar front surface 12 of the wall 3 is adjustable.

**[0072]** In an embodiment, the support structure 11, 11a, 11b comprises a horizontal strut 14b and a vertical strut 14a. In an embodiment, the vertical strut 14a is pivotally connected to horizontal strut 14b and an angle between the struts 14a and 14b is adjustable. In this case, the vertical strut 14a may not only have a strictly vertical orientation, but be skewed with respect to the vertical. As the strut 14b and the wall 3 are substantially in parallel (or at least at a fixed angle one with respect to the other), the use of an articulation between struts 14a and 14b makes it possible to orient the wall 3, and in particular the front side 12 of the wall 3 at a position other than vertical, for example with the top end of the wall skewed towards the back or towards the front. This feature allows designing further exercise options with the training system of the invention.

**[0073]** In an embodiment, the angle of the wall 3 with respect to vertical can be adjusted relative to the support structure 11, 11a, 11b, the support structure thus remaining fixed. For example, the wall 3 can be rotated forward or backward with respect to the support structure. For example, the wall 3 can be loosened with respect to the support structure so as to remain rotably connected to said support structure, for example to vertical strut 14a. The wall may then be tightened again to the support structure after the angle of the planar wall 3 has been adjusted as desired with respect to the vertical.

**[0074]** In an embodiment, the training system of the invention comprises a support structure 11 for stabilizing the wall structure 3 on the ground, wherein said wall structure 3 is height-adjustably connected to said support structure 11.

**[0075]** In an embodiment, said wall arrangement 2 comprises a support structure 11 at which said wall structure 3 is connected, wherein said support structure comprises a rail 15 and wherein said wall structure 11 is arranged to be guided in said rail 15 and comprises attachment means for blocking the wall structure 11 at a selected position along said rail 15.

**[0076]** The vertical strut 14a of each support structure 11a, 11b preferably comprises a rail 15. The rail 15 may be formed as a longitudinal slot within the vertical strut 14a, as shown in Fig. 1B, or may be formed by two parallel

vertical struts. Alternatively, the rail 15 may be a separate piece fixed on the vertical strut 14a or may be formed by a rim extending from the surface of the vertical strut 14a, for example.

**[0077]** The wall structure 3 preferably comprises protrusions (not shown) that are adapted to be received in the rail 15. Furthermore, the wall arrangement 2 comprises attachment means, for rigidly but detachably fixing the wall 3 at a selected vertical position along the rail 15. The attachment means may be formed by screws, for example. For example, a threaded bolt (not shown) may be rigidly fixed laterally on the frame 30 of the wall 3, extending horizontally away from frame in a direction that is parallel to the rear and front wall surfaces 12, 13. The bolt may be guided through the slot 15 and be attached by way of a nut on the other side of the slot, where the threaded bolt emerges. The nut may be in the form of a wing nut or any type of a hand-actionable nut, such that the height of the wall 3 may be adjusted by opening the nut by hand and retightening the nut by hand after having changed the height of the wall 3. Preferably, attachment means for attaching the wall structure 3 to the support structure 11a, are provided on the frame 30 of the wall 3. The invention also encompasses attachment means that are require the use of a tool for fixing or loosening a support structure 11a, 11b from the wall 3.

**[0078]** Preferably, the struts 14a-14c of the support structure 11, 11a, 11b are made from plastic. Preferably, the entire support structure 11 comprises and/or consists essentially of plastic.

**[0079]** Preferably, the struts 14a-14c comprise H-, T- or U-profiles, preferably H-profiles. For example, the horizontal strut 14b and/or the stabilizing strut 14c comprise H-, T- or U-profiles, preferably made from plastic, thereby providing stability while keeping the weight comparatively low and allowing transportability of the wall arrangement 2.

**[0080]** In an embodiment, the support structure 11, 11a, 11b preferably comprises a weight providing element 16. The weight-providing element preferably increases the stability of the wall arrangement 2 on the ground. In particular, the weight element 16 increases inertia of the entire wall arrangement 2, such that an inadvertent displacement of the wall arrangement 2 due to the impact of a ball on the wall arrangement is substantially prevented or impeded.

**[0081]** In a preferred embodiment, the weight-providing element 16 is detachably connected to the support structure 11a and 11b. In the embodiment shown in Fig. 1B, the weight element is connected to the rear extremity of support structure 11a and 11b, in particular the rear extremities of the horizontal struts 14b. The weight element 16 is preferably connected to both lateral support structures 11a and 11b. For example, the weight element 16 connects the respective horizontal struts 14b of the two support structures 11a and 11b, preferably at their rear ends. Preferably, the weight element 16 is essentially longitudinal, and extends horizontally, on the

ground. In a preferred embodiment, the weight element 16 extends in parallel to planes of the front and rear surfaces 12, 13 of the wall 3. The weight element 16 may provide a "rear strut" connecting the two lateral support structures 11a and 11b, thereby mechanically increasing stability of the support structure 11a, 11b, independently from the weight it may provide. Indeed, in some embodiments, the invention envisages that the weight element 16 is replaced by a strut that does not provide extra weight, and which may comprise a H-, L- or U profile as the horizontal strut 14a, for example.

**[0082]** In an embodiment, the training system of the invention comprises a support structure 11 for stabilizing the wall structure 3 on the ground, wherein said support structure 11 comprises a detachable, portable weight-providing element 16.

**[0083]** In a preferred embodiment, said weight element 16 comprises a water-tank.

**[0084]** Since the weight element 16 is detachable, it can be removed prior to displacement of the wall arrangement 2. When detached, weight element 16 does not render displacement of the wall arrangement more difficult. The weight element can be transported separately from the other parts of the wall arrangement. Preferably, the weight of the weight element can be carried by two persons. Preferably, the weight of the weight element is  $\leq 150$  kg, more preferably  $\leq 100$  kg, even more preferably  $\leq 80$  kg, and most preferably  $\leq 60$  kg.

**[0085]** If the weight element 16 is a water tank, it can be emptied before transportation, thereby rendering transport more convenient.

**[0086]** Instead or in addition to a weight element, the support structure 11, 11a, 11b may comprise means that allow fixing it to the ground. Preferably, the support structure 11, 11 a, 11b may be attached in a non-permanent, detachable manner. In an embodiment, the support structure comprises pegs, such as tent pegs, which can be driven into the ground /soil, such as to attach the support structure to the ground. In an embodiment, the support structure 11, 11a, 11b comprises a horizontal strut 14b comprising openings for receiving pegs, wherein the support structure is fixed by driving the pegs through said opening into the ground.

**[0087]** Figures 2A and 2B illustrate the targets of the wall structure 3 and the grid 5 of LED strips used to define said targets. Figure 1A shows two rows of grid areas 9a-9e and 10a-10e. Fig. 1A can also be considered to represent a front view to the front side 12 wall 3 of the embodiment shown.

**[0088]** An individual target, for example target 10b, is formed by four LED strips 41, 42, 43, 44, of the corresponding grid area. The LED strips 41-44 are arranged along the contour of a square, whereby the square may define the target 10b.

**[0089]** In an embodiment, the training system of the invention comprises a grid 5 of LED strips 41-47, wherein a segment in said grid 5 comprises an LED strip, and wherein a target 9 is defined and highlighted by lighting

segments of said grid 5 so as to highlight the contour of an area on said protective impact layer 4.

**[0090]** In an embodiment, the wall structure 3 comprises at least one horizontal row of targets 9a-9e, for example target areas. In a preferred embodiment, the wall structure 3 comprises at least two horizontal rows of grid areas or targets 9a-9e and 10a-10e, wherein targets of a first row 9a-9e are vertically aligned with targets of a second row 10a-10e. Fig. 2A shows that targets are vertically aligned. In this context, the invention allows the use of a grid 5 of LED strips for defining targets or target areas.

**[0091]** In an embodiment, the wall structure comprises further light emitting entity or light source 48, which is independent from the targets, and which does not define and/or be part of any particular target. The light source 48 is thus not part of the grid 5. The light source 48 is preferably an LED strip 48, similar to the LED strips forming the grid 5. In the embodiment shown, the light source 48 is a horizontally oriented, linear LED strip, provided in the top margin of the wall structure 3, for example above the grid 5. The separate light source may be used as part of particular exercise concepts. For example, in case of an exercise involving several wall structures as shown in Figs. 4A, 4B, 5B and 5C, the separate light 48 may be lit before lighting a particular target, so as to indicate to a player that a target has to be hit on the very wall structure on which the light source 48 is lit. Accordingly, light source 48 may be lit to draw a player's attention to one particular wall structure. The light source 48 may also be used to indicate the color used to highlight the next target to be hit. In short, the light source 48 may provide information to be considered by a player 39 conducting a training session with the training system of the invention. In more general terms, the separate light source 48 allows adding complexity with respect to the information that a player 39 is expected to consider in the course of a training session using the training system of the invention.

**[0092]** In an embodiment, the wall structure of the invention comprises a loudspeaker 40. The speaker 40 allows interaction with a player during exercising. In particular, the speaker 40 allows interaction based on sound signals, in addition to visual interaction based on the light sources of the wall arrangement 3. The loudspeaker 40 may be used to produce a particular sound for drawing the player's attention to one particular out of several wall arrangements, for example.

**[0093]** Figure 2B illustrates the indication or highlighting of a target 9 by way of LED strips. In this embodiment, a target is a rectangular and preferably square form or area, and the four sides of the rectangle or square are provided by four LED strips 41-44 (Fig. 2A). In other words, the targets are defined by the positions of the LED strips on the wall 3. Instead of rectangular or square target areas, the invention also envisages circular or elliptical targets. In this case, a single, circular LED string may be used for defining a target. The use of a plurality

of LED strings for defining a target 9 of the wall 3 is preferred however. As mentioned above, it is also possible to define a target as a cross or possibly a star, for example. The present invention is not intended to be limited to the exact shape of the targets.

**[0094]** An LED strip, for the purpose of the present invention, may be a series of aligned Light Emitting Diodes (LEDs), whereby the LEDs may be aligned along a curved or straight line, preferably a straight line. Preferably, the LED lights of an LED strip are visible as a line when turned on so as to be illuminated. Alternatively, an LED strip is a single LED light, which is positioned so as to highlight an entire segment of the segmented display. In accordance with the invention, an LED strip may also be replaced by a neon tube.

**[0095]** In an embodiment, the invention envisages that an LED strip and/or display segment is provided by any type of light source. One may envisage, for example, using a neon tube instead of a LED strip.

**[0096]** From the LED grid 5 shown in Figs 1B, 2A and the highlighted target 10b in Fig. 2B, the skilled person becomes aware of how a particular target is highlighted in accordance with the embodiment shown in the figures.

**[0097]** For the purpose of the present specification, the verbs "to highlight", "to indicate", "to mark" or "to activate" a target, and various grammatical forms thereof, are used for referring to the situation shown in Fig. 2B, where the target 10b is visibly marked by illumination of LED strips 41-44. It is possible to highlight several targets on a wall 3 of the invention, and even all targets may be highlighted.

**[0098]** As becomes apparent from Figs 2A and 2B, four LED strips 41-44 making up the sides of a square are lit, thereby, highlighting a target 10b, which corresponds to the square formed by the four LED strips.

**[0099]** A lit LED strip may appear as a dotted line, due to the fact that individual LEDs in a particular LED strip are spaced apart, and the observer may notice individual LEDs (see Fig. 3).

**[0100]** As becomes apparent, some LED strips form the sides of two grid areas, in particular of two neighboring grid areas and/or two grid areas one lying vertically directly above the other. For example, LED strip 44 would also be lit for highlighting the grid area 10a that is left of the target 10b in Fig. 2A. This is the implicit consequence of the fact that the targets are defined by a grid 5 of LED strips as shown in Fig. 1B.

**[0101]** The training system also allows the creation and highlighting of larger targets, composed of adjacent grid areas, for example. With reference to Fig. 2A, a rectangular, but non-square, target may be formed by highlighting LED strips 42-47. In this case, LED strip 41 is not switched on, and the resulting, rectangular target area is composed of squares 9b and 10b in Fig. 2A. It would also be possible to use horizontally adjacent grid areas, for example areas 10a and 10b for defining an own, new target.

**[0102]** In accordance with an embodiment, the present

invention determines an impact position independently from the position and occurrence of grid area or target on the wall structure. In accordance with the invention, this is achieved by using sound sensors in such a way so as to create a tactile impact surface 12, formed by impact board 4, which allows determining the position of an impact anywhere on said tactile surface. The targets, on the other hand, are independent from the position of the sound sensors, and as such the targets are at least in part definable by a user of the training system. For example, a single square of a grid 5 or, alternatively, two adjacent squares may be used for defining a target that can be highlighted. In the same line, a target may be defined by four squares of the grid 5, for example squares 9a, 9b, 10a and 10b in Fig. 2B, thereby forming a larger square target. The skilled person will appreciate that the use of a grid of LED strips provides flexibility with respect to the definition of targets on the wall structure. In particular, the size, shape (contour) and position of targets may be determined by the user. These options are limited only by the "mesh-size" of the grid 5, or, in other words, by the length of the LED strips forming a square.

**[0103]** In accordance with an embodiment, the wall arrangement of the invention provides target areas of different sizes and/or shapes. The training system is configured to enable a user to define parameters (size, shape) of targets.

**[0104]** In an embodiment, the wall structure 3 comprises LED strips forming a grid 5, wherein an individual LED strip 44 forms an essentially straight-line segment of said grid 5, and wherein one or more individual LED strips can be illuminated simultaneously to create targets, but also numbers, letters and/or symbols formed on said grid 5 by individually illuminated LED strips. Examples of symbols are arrows or smileys.

**[0105]** The use of a grid 5 of LED strips (or neon tubes) for defining targets has further advantages. In an embodiment, the LED strips are used as part of a display going beyond the highlighting of a particular target. In particular, the LED strips may be used to form a display for providing numbers, figures, letters, symbols or other forms, as considered useful. For example, the LED strips may be used for generating letters. Preferably, the same LED strips that are used for indicating or highlighting a target may also be used for creating letters or even words that are visible to a player. In this manner, the LED strips provide a real display. **Figure 2 C** is an alternative embodiment of the wall structure 3 of the invention. Instead of LED strips or neon tubes as disclosed above, an array of LEDs is provided so as to form a display, which is suitable to highlight targets or produce figures, letters or numbers. The LEDs may be placed in openings in the support layer 6, in an analogous manner as described above with respect to the grid of LED strips. The array of LEDs has the advantage that many more display possibilities and in particular a higher display resolution can be provided. Fig. 2C is a front view to the front surface of the wall 3. By lighting specific LEDs out of the array 50 of LEDs,

targets can be highlighted and/or formed on the screen that is provided by the wall. In this regard, the entire wall arrangement is a screen as well as a tactile surface. Black dots 51 and 52 represent lit LEDs, whereas the grey dot 53 represents an unlit LED of the LED array. The unlit LEDs may actually not be visible in reality, depending on the characteristics of the front board 4 in terms of transparency. In Fig. 2C, unlit LEDs are shown as grey dots, so as to illustrate the array formed by the LEDs and also the definition of a target by lighting appropriate LEDs of the array.

**[0106]** In the wall 3 of Fig. 2C, any LED (dot) can be lit independently from any other dot. This is different from the embodiments based on a grid of LED strips, where the LEDs of one strip or grid segment are generally all lit simultaneously, so as to light a particular segment of the grid 5.

**[0107]** **Figure 3** illustrates the creation of the word "no" by highlighting appropriate LED strips of the wall structure 3. Furthermore, Fig. 3 illustrates the use of RGB LEDs, which can produce any color on the basis of one red, green, and blue LED forming a RGB LEDs. The straight line on the bottom on the wall in Fig 3 is formed by a series of adjacent LED strips in which each LED strip is lit with a different color. In particular, in Fig. 3, the letter "n" is written in blue, the letter "o" in red, and the colors of the highlighted LED strips or grid segments forming the line on the bottom are, from left to the right, green, blue yellow, purple and white.

**[0108]** In an embodiment, the invention provides the highlighting of targets with different colors. The user of the system may determine the color and brightness with which a target is highlighted, for example in dependence of daylight conditions. The color and brightness may be selected so as to allow more rapid identification of a highlighted target to be hit by a player, or, on the contrary, to render the identification of a highlighted target more difficult. Such parameters may be selected in dependence of skills to be trained and exercise purpose. The letters of the word "no" in Fig. 3 are formed by the horizontal and vertical lines of the LED strips. The letters are thus in a way digital letters.

**[0109]** Since, in the embodiment shown the targets are formed by LED lights, in particular a grid of LED strips, one may use the grid as seven-segment font or display, for indicating figures or numbers, for example. In order to provide a seven-segment display, the grid should comprise at least two rows of squares, as is the case in the grid 5 shown in Figs 1B and 2A. Accordingly, in an embodiment, the LED strips used to define targets form a seven-segment display.

**[0110]** In an embodiment, the invention encompasses any segmented font display, for highlighting target areas and/or indicating figures and/or numbers. Instead of a seven segment font or display, the invention encompasses any digital, multi-segmented display, including digital displays comprising less or more than seven segments. For example, the wall may comprise a grid of LED strips

or LED lights forming a 4-segment, 7-segment, 9-segment, 14-segment, 16 segment display. Preferably, the wall may comprise a grid of LED strips or LED lights forming a 7-segment display. Preferably, the wall comprises a grid of LED strips or lights (or neon tubes) forming a segmented and/or digital display comprising from 4 to 32, preferably 7 to 16 segments.

**[0111]** In an embodiment, the wall structure 3 comprises light sources 5 arranged to indicate and/or highlight a particular target 10b to be the target to be hit by a ball, and/or wherein said light sources 41-47 are configured and/or arranged to be used as a display for displaying one or more selected from numbers, letters, words, symbols or a parameter related to a result of an exercise and/or particular ball hit.

**[0112]** Figures 4 A and 4 B illustrate the electronic system of the training system 1 of the invention. The training system 1 preferably comprises one, two or more wall arrangements. The training system 1 shown in Figs 4A and 4B comprises four wall arrangements 2.1-2.4. Each of the wall arrangements 2.1-2.4 may have the construction as shown in Fig. 1B, for example. Each wall arrangement 2.4-2.4 comprises its own local electronic system 8.1-8.4, respectively, which preferably comprises an own local circuit card assembly and microcontroller including wireless communication modules. Herein below, the local circuit card assembly and microcontroller will be referred to in a simplified manner as "the microcontroller" or "the local microcontroller".

**[0113]** The local microcontrollers 8.1-8.4 preferably have two main tasks. On the one side, they are connected, via cable, to the sound sensors of the wall arrangement in which they are provided. Based on the signals received from the sound sensors, the local microcontrollers 8.1-8.4 determine the position of an impact of a ball on the respective wall.

**[0114]** In a preferred embodiment, said sound sensors are piezoelectric sensors.

**[0115]** The wall 3, and in particular the front impact layer 4, operates as a tactile surface, on which a position of an impact is determined by way of said sound sensors. In this specification, reference numeral 8 is used to refer to the microcontroller of any one wall 3, for example to any one of the microcontrollers 8.1-8.4.

**[0116]** On the other side, the microcontroller 8 is connected via cable to the LED strips of the LED grid 5 (Fig. 1 B). Accordingly, the microcontroller is configured to highlight any particular target by lighting the respective LED strips. In the embodiment shown, the microcontroller 8 is configured to light any one LED strip. For highlighting one target on the wall 3, for example, the microcontroller switches on four (4) LED strips forming a square, for example LED strips 41-44 in Figs 2A and 2B.

**[0117]** Furthermore, the local circuit card assembly of the local microcontroller preferably comprises a network card, for enabling wireless communication with the control unit 20.

**[0118]** The local electronic systems of each wall struc-

ture 3 further comprises a power source, which is preferably selected from portable power sources, such as batteries and rechargeable batteries. Alternatively, but less preferred, the invention also envisages that the local electronic systems 8.1-8.4 and the LEDs are powered via electric cable.

**[0119]** It is noted that the sound sensors (not shown) are suitable to determine the exact impact position of a ball on the impact board 4. From the data received, the microcontroller (or the control unit 20) may also determine further parameters, such as impact force or strength and smoothness. Accordingly, the ball game training system of the invention is configured to determine the position of an impact, the strength or force of an impact, as well as the smoothness of an impact. In this regard, the smoothness is dependent on the material and/or hardness of a ball impacting on the wall structure. A hard ball impacting on the front surface 12 of the impact layer 4 will not produce the same sound waves as a soft ball. A further parameter that can be assessed is the reaction time, which may be defined as the time between the highlighting a target and sensing an impact on the wall 3, for example. The determination of the reaction time may take the distance between the player and the wall into account, as well as the speed of the ball. The distance between a player and a wall of the invention may be determined as specified elsewhere in this specification. The speed of the ball may be determined on the basis of the strength of the impact of the ball on the wall.

**[0120]** The training system 1 comprises a control unit 20, which is configured to communicate with the microcontrollers 8.1-8.4. In a preferred embodiment, the control unit is the main computing entity, comprising in particular a CPU, RAM and a hard drive, a motherboard or main circuit board, a network card and a Bluetooth card, for example. In the embodiment shown in Fig. 4A, there is only a single control unit 20 for controlling all wall arrangements 2.1-2.4. The control unit 20 may be physically separated from the wall arrangements 2.1-2.4. For example, the control unit 20 may be in the form of a box, which is transported as a separate "piece" but together with the wall arrangements for the purpose of conducting exercises.

**[0121]** In an embodiment, said control unit 20 comprises a memory unit on which data related to exercises and to the input from said sound sensors are stored by said control unit 20. Such data can be transferred to the portable device 22, as will be described in more detail elsewhere.

**[0122]** In an embodiment, the training system 1 of the invention comprises a plurality of wall arrangements (2.1, 2.2, 2.3, 2.4), wherein said wall arrangements are connected via a wireless communication module, and wherein, for any particular exercise to be conducted, any wall arrangement can be positioned and/or oriented on an exercising ground independently from the position and/or orientation of any other one of said plurality of wall arrangements.

**[0123]** Preferably, each wall arrangement comprises its own power source, such as a battery, for providing the required electric energy for all electric and electronic components of the respective wall. Preferably, each wall arrangement comprises an own rechargeable battery. The power source provides the energy required by the control unit 20 and the microcontroller 8. It is also envisaged, though less preferred, that the control unit 20 connected via an electric cable to a power supply.

**[0124]** In an alternative embodiment, the control unit 20 in Fig. 4A is integrated in one of said wall arrangements, for example in wall arrangement 2.1.

**[0125]** In an embodiment, the training system of the invention comprises a plurality of wall arrangements 2.1, 2.2, 2.3, 2.4, wherein electronic components of said wall arrangements are configured to communicate with each other via a wireless communication module and wherein each wall arrangement is configured to be positioned with respect to any other wall arrangement. For example, a wall arrangement can be positioned to be free standing with respect to the other wall arrangements. Preferably, it is also possible to connect a wall arrangement to another wall arrangement.

**[0126]** Each wall arrangement 2.1-2.4 preferably comprises its own speaker 40.1-40.4, respectively, as has been detailed with respect to Fig. 2A. The speakers are preferably connected to and controlled by the control unit 20. In the embodiment shown in Fig. 4A, the speakers may be wirelessly connected to the control unit 20. Alternatively, the speaker may be connected to the respective local microcontroller 8.1-8.4, for example by cable, and may thus be controlled via the microcontroller.

**[0127]** In an embodiment, the ball game training system of the invention comprises a RFID (radiofrequency identity) system 49.1-49.1, 54. The RFID system may be of any type, such as Active Reader Active Tag, Active Reader Passive Tag or Passive Reader Active Tag. An Active Reader based system is preferred. The RFID reader is preferably part of the wall arrangement 2.

**[0128]** In an embodiment, each wall arrangement 2.1-2.4 comprises a respective RFID tag reader 49.1-49.1. The RFID tag reader is configured to communicate with portable RFID tags 54 (Figs 5B and 5C) that can be carried by players 39 conducting exercises with the training system of the invention. In this manner, the training system 1 of the invention can identify the player that is conducting an exercise.

**[0129]** Preferably, the RFID reader of each wall arrangement is connected to the control unit 20. Alternatively, the RFID reader 49.1-49.4 may be connected to the respective local microcontroller 8.1-8.4, for example by cable, and may thus be controlled via the microcontroller.

**[0130]** The start and end of training exercises is triggered by a user 23 via a portable data processing unit 22, which is preferably selected from a portable computer, for example a notebook, a portable computer pad (an ipad, for example) and/or a smartphone. The portable

data processing unit 22 is also referred to as portable device 22 in this specification. The portable device 22 provides the user interface for the training system 1 of the invention. Preferably, the portable device comprises a touch screen display. Using the portable device 22, the user 23 may select a particular exercise selected from exercise options, may enter information and usernames of players that participate in exercising, and may enter parameters of exercises. This information is sent via a wireless connection to the control unit 20. In a preferred embodiment, the connection between the portable device 22 and the control unit 20 (the dashed line in Fig. 4A) is a Bluetooth connection.

**[0131]** In an embodiment, the training system of the invention comprises a portable computing device 22, wherein said portable computing device 21 is configured to communicate via a wireless connection 21 with said control unit 20, and wherein said portable computing device 22 comprises an interface for a user 23.

**[0132]** In an embodiment, the training system of the invention is configured to be run and controlled by a user via a portable computing device 22, such as a smart phone or computer pad. In particular, the training system comprises application (software) that can be installed on the portable device. The software on the portable device 22 is configured to communicate with the control unit 20 via the wireless hardware of the portable device, for example via Bluetooth or Wi-Fi. To this end, each wall arrangement comprises a wireless adaptor (not shown), which is preferably part of the respective local microcontroller 8. Any kind of radio wave-based communication can be used, such as 2.4 GHz radiofrequency, for example.

**[0133]** In an embodiment of the training system of the invention, said control unit 20 comprises software entities related to different exercise options, and wherein said interface enables said user 23 to select and start a particular exercise option.

**[0134]** Following receipt of exercise instructions via portable device 22, the control unit 20 contains and is configured to run appropriate software codes corresponding to particular exercises. The control unit 20 thus functions as a "sequencer", in that it sends instructions with respect to the sequence of targets to be highlighted on the wall arrangement(s) involved in a particular exercise to the local microcontroller 8.1-8.4. The expression "sequence" is used to point out that individual targets 9 are generally highlighted one after the other in the course of an exercise. The control unit 20 also sends instructions with respect to the duration of highlighting of a target and the time lapse between the highlighting of two different targets. Depending on the exercise type and the number of wall arrangements 2.1-2.4 involved in a particular exercise, the control unit 20 may highlight a sequence of targets of a single wall arrangement, or may highlight a series of targets distributed over a plurality different wall arrangements.

**[0135]** The software contained on the control unit 20,

20.1-20.4 is preferably transferred from the portable device 22. Accordingly, a user may define and create own training sessions, involving a desired number of wall arrangements and involving a predetermined or randomized sequence of highlighted targets. The own exercise may transferred via the portable device to the control unit, and can then be activated via the portable device. In this manner, new exercises can rapidly be generated and conducted by the training system of the invention.

**[0136]** In an embodiment, the control unit 20 is configured to cause lighting of light sources so as to highlight a target 9 on said wall structure 3, and/or to highlight a sequence of different targets of said wall structure 3.

**[0137]** **Figure 4 B** shows a preferred embodiment of the electronic system for controlling and operating the training system 1' of the present invention. The difference with respect to the embodiment shown in Fig. 4A is that each wall arrangement 2.1'-2.4' comprises its own control unit 20.1-20.4, respectively. The presence of a local control unit facilitates the separation of the wall arrangement and the performance of different exercises with different wall arrangements. For example, a user 23 may use wall arrangement 2.1' for training using a particular exercise involving only one wall arrangement, and using the remaining wall arrangements 2.2'-2.4' for conducting another, different or separate exercise involving one or more of the remaining the three wall arrangements 2.2'-2.4'. Different types of exercises that can be performed with the training system of the invention will be illustrated in more detail further below.

**[0138]** In an embodiment, the training system 1' of the invention comprises a plurality of wall arrangements 2.11-2.4' comprising local electronic systems 8.1-8.4 and 20.1-20.4, wherein one wall arrangement can be used alone or a plurality of wall arrangements can be combined to conduct exercises.

**[0139]** Fig. 4B illustrates the coordination of all wall arrangements 2.1'-2.4'. In this case, the control unit 20.1 of one of the wall arrangements functions a "master", whereas the electronic systems of the remaining wall arrangements act as "slaves", following instructions received from the master 20.1 and/or sending data to the master 20.1. In the embodiment shown, the master control unit 20.1 interacts directly with the local microcontrollers 8.1-8.4. The local control units 20.2-20.4 are thus not activated and do not send or receive any data and/or instructions. In an alternative embodiment, the master control unit 20.1 may interact with the local control units 20.2-20.4 and send instructions to the latter. In all cases, the master control unit 20.1 receives information with respect to an exercise to be conducted via wireless communication, for example via Bluetooth, from the portable device 22 of the user 23.

**[0140]** In an embodiment of the invention, each wall arrangement 2.1-2.4 comprises an own local circuit card assembly 8.1-8.4 comprising a wireless communication module, and wherein the training system comprises a control unit 20, 20.1, configured to communicate via wire-

less communication with said local circuit card assemblies 8.1-8.4. Preferably, communication between the control unit 20, 20.1 and the local circuit card assemblies is conducted by radio waves, for example at 2.4GHz, zigbee, wifi, or Bluetooth, for example.

**[0141]** Preferably, the control unit comprises further wireless communication module, for example a Bluetooth module, for communicating with a portable 22 device. The portable device provides the user interface of the training system of the invention.

**[0142]** Regarding the RFID system of the embodiment shown in Fig. 4B, the reader 40.1-40.4 of the respective board is preferably connected to the local control unit 20.1-20.4 or to the local microcontroller 8.1-8.4. In case of several wall arrangements that are controlled by a single control unit 20.1, the invention envisages that the master control unit 20.1 is connected to the RF ID tags via the local microcontrollers or the local control units.

**[0143]** For the purpose of the present specification, reference to a control unit 20 encompasses reference to control unit 20.1-20.4 as shown in Fig. 4B. The expression "control unit 20" thus generally encompasses (except in case of the specific embodiment as shown in Fig. 4A) the embodiment where different wall arrangements each have their own control unit as shown in Fig. 4B.

**[0144]** **Figures 5 A - C** illustrate different exercises that can be performed with the training system 1, 1' of the invention. These figures also illustrate how the training system of the invention can be operated.

**[0145]** **Fig. 5 A** illustrates a football exercise using only a single wall arrangement 2. It is noted that Fig. 5A is schematic and the details of the wall arrangements, such as the support structure of the wall arrangement are not shown. In Fig. 5A, only the front side of the wall structure 2 is visible, on which targets can be highlighted. The separate light source 48, the speaker 40 and the RFID reader 49 are preferably also present, but are not specifically shown.

**[0146]** Furthermore, the particular wall arrangement 2 in Fig. 5A comprises three rows of grid areas, instead of the two rows shown in Figs 1-3. The present invention is not limited to a particular number of rows, however, it is preferred that grid areas and/or targets in subsequent rows are positioned vertically above or below each other, respectively. This is related to the grid-like arrangement of the LED strips as shown in Fig. 1B.

**[0147]** The wall arrangement 2 is placed in a goal 34 and can be used for training penalty kicks, or kicks on the goal in general. A player 39 is in front of the goal. When the exercise starts, the training system 1 highlights a target 9e, which the player tries to hit with the ball 33 by kicking the ball. Typically, the player 39 does not know in advance which of the targets on the wall arrangement 2 will be highlighted. From the player's perspective, the target 9e is arbitrarily highlighted. This allows training and assessing not only accuracy but also the reaction time. When the user 23 configures and/or starts a particular exercise, the system envisages an operation

mode where the training system and in particular the control unit 20/20.1 (Figs. 4A and B) randomly highlights a target of the wall arrangement 2, or highlights a target as predetermined by the user 23 (Figs 4A and 4B).

**[0148]** The user 23 is generally a trainer, but the player 39 may also train autonomously and be at the same time the user 23 who uses the portable device 22 for starting an exercise. In other words, the user 23 and the player 39 may be the same or different persons.

**[0149]** In an embodiment, the training system of the invention is configured to create an exercise automatically for training a specific competence. Competences or skills that may be trained using the ball game training system of the invention include reactivity (reaction time), shot accuracy or precision, management of information and decision taking (for example if two choices are offered by highlighting two different targets), dosing of shot strength (determining if shot strength is appropriate to a particular exercise situation), for example.

**[0150]** In an embodiment, the training system of the invention is configured to conduct an exercise implying a single wall arrangement 2.1 and to conduct another exercise involving several wall arrangements 2.1-2.4; 2.1'-2.4', wherein, in an exercise involving several wall arrangements 2.1-2.4; 2.1'-2.4', one or more targets 9 on any one of said several wall arrangements 2.1-2.4; 2.1'-2.4' may be highlighted.

**[0151]** Figure 5 B illustrates an exercise using several wall arrangements 2.1-2.4. In particular, the wall arrangements 2.1-2.4 are positioned around a player 39. When the exercise starts, a target may be highlighted on any one of the wall arrangements. This exercise may be part of cognitive training and/or training not only for training and assessing ball hitting accuracy, but also reaction time and a player's overview. The player has to check rapidly and regularly where the next ball should be kicked. Depending on where the wall arrangements are positioned around the player, one can determine the angle around the player that the player should cover, such as 360°, if a perfect overview in all directions is to be trained. By omitting one wall arrangement in Fig. 5B, an angle of about 180° with respect to the player placed in the center is obtained. Exercises based on the disposition of the wall arrangements as illustrated in Fig. 5B may in particular make use of the speaker 40 for interacting with the player and/or adding complexity or information to particular exercises.

**[0152]** Figure 5 C illustrates another exercise using several wall arrangements 2.1-2.4. In this exercise, the player 39 has to move along a track 55 and train passing the ball while generally being in motion and advancing with the ball. In this exercise, there will generally be a target highlighted on successive wall arrangements 2.1, 2.2, 2.4, 2.3, such that the player knows on which wall 3 the next target will be, but the player 39 does not know in advance which target to hit on a particular wall. Fig. 5B thus illustrates a pass-training exercise. The arrow 56 indicates the possible trajectory of the ball after being

kicked by player 39, whereas the arrow 57 indicates the ball's trajectory after rebound from the wall 2.1. In the exercise as shown, the player remains in motion, for example, advances along a preconceived, ideal track 55 from where the player is expected to hit highlighted targets on successive walls along the track.

**[0153]** In an alternative exercise based on the system as installed in Fig. 5C, another person (not shown), may pass a new ball to the player after a kick of the player on a wall.

**[0154]** In an embodiment of the invention, the ball game training system is configured to determine the position and orientation of each wall arrangement 2.1-2.4 in space, in particular on a sportsground. This may be achieved in several manners. In one embodiment, each wall arrangement comprises an own GPS (Global Positioning System). The local GPS may be connected to or part of the local control unit 20 or of/to the local microcontroller 8, in case a single control unit is used as shown in Fig. 4A. In an alternative embodiment, the wall arrangement does not comprise an own GPS, but is configured to determine its position via the GPS contained in the mobile device 22. In accordance with this embodiment, the local microcontroller 8.1-8.4 or the control unit 20, 20.1-20.4 is configured to determine the position and orientation of the respective wall arrangement when the mobile device 22 is put in a particular manner close to the respective wall arrangement. For example, the control unit 20 comprises a software code communicating with the mobile device 22. Using this software, the control unit 20 may determine the position of the mobile device. Via the interface provided on the mobile device 22, a user 23 may trigger the control unit 20 to determine the position and/or orientation of the mobile device at the very moment the mobile device is placed in a defined position with respect to a particular wall arrangement. Then, the user 23 may let the control unit 20 know that the mobile device is in the required position for determining the position of a particular, identified wall arrangement, so that the control unit can determine the position of that very wall arrangement. If the training system 1 comprises several wall arrangements, such as four wall arrangements 2.1-2.4, the procedure has to be repeated for each wall arrangement.

**[0155]** In an embodiment, the ball game training system comprises means that allow a wall arrangement 20.1 to localize one or more of the respective other wall arrangements 2.2-2.4.

**[0156]** In an embodiment, each wall arrangement 2.1 is configured to receive and/or to gather information with respect to its own position and/or orientation and the positions and/or orientations of the other wall arrangements 2.2-2.4. In particular, a given wall arrangement receives or is configured to determine autonomously the position and/or orientation of the respective other wall arrangements. A control unit 20, for example, a master control unit 20.1, may receive from each wall arrangement the position and/or orientation of the respective wall arrange-

ment, and may make this information available to each wall arrangement. For example, the master control unit 20.1 may communicate with the local control units 20.2-20.4 and distribute the information with respect to position and/or orientation.

**[0157]** In an embodiment, each wall arrangement comprises magnetic sensor connected to the local control unit. On the basis of the magnetic sensor (not shown), the control unit contained in a wall arrangement 20, 20.1-20.4 may determine the orientation of the wall arrangement with respect to the earth's magnetic field.

**[0158]** Once the control system 20 knows the position of the wall arrangements 2.1-20.4, a radio wave-based system may be used to estimate or identify the position of a particular player 39. In particular, the position may be estimated and/or determined via a radio wave emitter carried by a player 39, for example by triangulation. The position of a player 39 may be determined by triangulation, using the arrival time of waves emitted by the portable emitter at sensors (not shown) present in the wall arrangements 2.1-2.4. A radio wave sensor in a wall arrangement may be connected to the local microcontroller or local control unit. It is preferred that there are at least three walls 3 comprising sensors for determining the position of a player 39 carrying an emitter.

**[0159]** It has been specified above that the players may be equipped with an RFID tag 54. The device containing the RFID tag may also harbor the active emitter for determining the position of the players. Preferably, the RFID tag and the emitter for determining position are contained in the same portable device. In this embodiment, reference numeral 54 in Figs 5B and 5C refers to a portable device comprising the RFID tag and the radio wave emitter for determining position. In this case, a power source, such as a battery, should also be present in device 54. In another embodiment, the portable device 54 is only a RFID tag (lacking the emitter for determining the position) or only a radio wave emitter for determining the position of a player by triangulation (lacking the RFID tag), for example.

**[0160]** In an alternative embodiment, a technology based on another principle may be used for determining the position of a player, such as the iBeacon system, which is based on low energy consumption transmitter, which can be carried by a player.

**[0161]** In another embodiment, the training system of the invention comprises a camera which is positioned so as to take images of the sportsground on which the wall arrangements are positioned. The position of a player may then be determined, monitored and tracked by image analysis.

**[0162]** In an embodiment, the training system provides a system for identifying the position and/or orientation of a player on a sportsground and/or with respect to one or several wall arrangements.

**[0163]** In an embodiment, the training system of the invention runs exercise programs, in which a particular player that is conducting an exercise is indicated or pre-

entered before starting an exercise, such that the training system "knows" at each moment which player is in course of conducting an exercise. The identity can also be determined and/or confirmed by the presence of an RFID tag carried by the players.

**[0164]** In an embodiment, the training system 1 of the invention comprises means for determining the position of a player on a sportsground and/or with respect to the wall arrangements. Preferably, the training system 1 is equipped and/or configured to determine the distance between a wall arrangement and a player 39. Preferably, the training system 1 is equipped and/or configured to determine the orientation of a wall arrangement with respect to a player 39, and/or the angle of the player 39 with respect to the front surface of a wall 3.

**[0165]** Figs 5A to 5C illustrate well the advantages of providing free-standing as well as displaceable wall arrangements. In an embodiment, the wall arrangements are not attached one to the other. Preferably, a wall arrangement does not comprise and is thus free of means for attaching it to another wall arrangement.

**[0166]** These wall arrangements impose no limit with respect to the placement on the ground. They may also be stacked, one wall arrangement being placed on top of the other. In an embodiment, said wall structure 3 is a first wall structure 3.1, wherein said first wall structure comprises means for connecting a second wall structure 3.2 on top of said first wall structure 3.1 and/or at the left or right lateral side of said first wall structure 3.1.

**[0167]** An assembled wall structure composed of two or more stacked walls can be obtained, for example. Wall arrangements may also be arranged side by side and/or stacked. For example, a single large-sized wall arrangement of two wall arrangements, one stacked on top of the other, and/or of four wall arrangements comprising two pairs of stacked walls positioned one next to each other, may be arranged. The side-by-side positioning and stacking allows increasing the surface area and/or height of wall arrangements by assembly. Preferably, the wall arrangements comprise complementary attachments means allowing the connection of wall arrangements one besides the other or one on top of the other. Such attachment means may be provided, for example, on the lateral sides 18a and 18b of the frame 30 of the wall arrangement (Fig. 1 B), or on the support structures 11, 11a, 11b. Such attachment means may include threaded attachments, click connections, bayonet connections, and the like.

**[0168]** As will be appreciated, the versatility with respect to the free positioning of individual wall arrangements and the assembly of wall arrangement allows the creation of a nearly unlimited number of different exercises. Thanks to the system using a (master) control unit 20 controlling a group of several wall arrangements, a user 23 can create exercises (training sessions) based on a desired number of wall arrangements. The user may chose 1, 2, 3, 4 or more wall arrangements for use in a particular exercise. The wall arrangements may be positioned in any orientation one with respect to the other.

Yet, a single control unit 20, 20.1 (Figs 4A and 4B) is configured to conduct an exercise program involving the desired number of wall arrangements. Furthermore, the system of the invention allows free determination of the distance between a player and a target. For example, the radius of the approximately circular disposition of wall arrangements shown in Fig. 5B may be freely determined by the user.

**[0169]** The ball game training system of the invention provides the possibility of registering particular players, storing results of exercises conducted with a particular player, and perform statistical analysis of the results of a player. For example, it may be assessed whether results of an individual player in a particular exercise improve, how fast they improve, and so forth. The training system comprises a memory unit, preferably on the control unit 20, 20.1 or on the portable device 22, for storing results recorded during an exercise session with an individual user. In an embodiment, the system of the invention provides the creation of a (global) performance indicator, which may be determined on the basis results achieved by a player with respect to a combination of different exercises. Statistical analysis may also conducted with respect to the performance indicator, for assessing improvement of performance and speed of improvement, for example.

**[0170]** In accordance with an embodiment, the invention provides determining a score based on each particular ball impact, wherein the score takes several parameters into account, such as accuracy and strength of a hit (impact force). The term "accuracy" is used in this specification to refer to the closeness of a ball impact on the wall to the center of a highlighted target. For example, an impact outside an area defined as a target means lower accuracy than a ball hit inside an area or zone that is highlighted as a target.

**[0171]** The portable device 22 preferably comprises an application or software configured to represent results graphically.

**[0172]** Likewise, it is possible to compare the results of different players achieved in a particular exercise using the training system of the invention.

**[0173]** Exemplary parameters that can be determined with the system of the invention may be selected from the group of ball hitting accuracy, the force and strength of an impact on the wall, and thus of a ball hit, the time lapse between highlighting of a target and impact (reaction time), for example.

**[0174]** Interestingly, the system of the invention allows a user 23 to define an own exercise. Parameters of an own exercise can be: the number of wall arrangements involved, the time gap between highlighting targets, the order or sequence of highlighting targets, the number of targets highlighted at the same time, the distribution of the sequence of highlighting targets over the wall arrangements. For example, a user may wish to have a targets highlighted in a completely arbitrary manner, such that a particular target on any one wall arrangement may

be highlighted. Alternatively, the user may determine that an arbitrary target on a determined wall arrangement is highlighted, that arbitrary targets on a predetermined sequence of wall arrangements are highlighted, that a determined target on an arbitrary wall arrangement is highlighted, and so forth.

**[0175]** In an embodiment, the training system allows a sequence of targets to be highlighted in a predetermined manner, for example specifically determined by the user, which configures the control unit accordingly. In this case, the user specifies each particular target to be highlighted and the sequence of highlighted targets. The training system also enables a sequence of targets to be determined by an algorithm, for example by chance or in accordance with a particular rule or pattern.

**[0176]** In exercises conducted with the training system of the invention, it is also possible to have several different targets highlighted at the same time, for example two targets on one wall arrangement or two targets on two different wall arrangements, or three targets being highlighted at the same time, and so forth. If several targets are highlighted at the same time, they may be highlighted with the same or different colors, as described elsewhere in this specification. The training system provides exercises, where a player is expected to decide between different options (different highlighted targets). Such exercises may aim at training and assessing a player's capacity to take a decision, and possibly to take the best decision for a given situation.

**[0177]** In another exercise, a target remains highlighted for some time only, and if there is no impact occurring within a determined period of time, the highlighting of this target stops, and another target is highlighted. This option may be used in exercises aiming at training reaction time. The software running the exercise and evaluating a player may apply a penalty (score subtraction) for every highlighted target that is switched off without an impact having been determined.

**[0178]** The invention provides that exercises and/or training sessions may be created individually using the software on the portable device 22, and that exercise parameters or software be transferred from the portable device to the control unit 20, 20.1-20.4 of the wall arrangements, from where they are run. In other words, the portable device 22 can be used for upgrading the software on the control unit 20, 20.1-20.4, or more generally for downloading software in the control units via wireless communication.

**[0179]** The present invention encompasses ball game training systems comprising one or several wall arrangements 2. In an embodiment, the training system 1 comprises only a single wall arrangement 2. In this case, when the present specification makes reference to a plurality of substantially identical equipment present on several wall arrangements is to be understood as reference to a single such equipment. For example, the statement "each wall arrangement 2.1-2.4 comprises a local micro-controller 8.1-8.4" is to be understood as "the wall ar-

rangement 2 comprises a local microcontroller 8", in case of a training system comprising only a single wall arrangement 2. The same principle applies to the local control units 20.1-20.4, the RFIF tag readers 49.1-49.4 and the speakers 40.1-40.4. On the other hand, the present invention encompasses training systems comprising 2, 3, 4, 5, or more separate wall arrangements. The invention also envisages that a subgroup of the wall arrangements 2 (e.g. 2.1 and 2.2) may be used for a particular exercise, while another subgroup (2.3 and 2.4) are used simultaneously in another exercise.

### Claims

1. A ball game training system (1) comprising a wall arrangement (2) comprising a layered wall structure (3), said wall structure (3) comprising a wall a front side (12) on which a plurality of targets (9) can be defined, wherein said front side of said wall structure (3) is covered by a protective impact layer (4) comprising a material that enables the conduction of sound waves across said protective impact layer (4), said wall structure (3) further comprising a support layer (6) with which said protective impact layer (4) is in contact, wherein said wall structure (2) comprises at least one sound sensor (7) arranged so as to sense sound produced from an impact of a ball on said protective impact layer (4), and wherein said training system (1) further comprises a control unit (20) receiving data from said sound sensor (7), said control unit (20) being configured to determine the impact point on said protective impact layer (4) of a ball hitting said impact layer (4) from the data produced by said sound sensors (7).
2. The training system of claim 1, comprising a grid (5) of LED strips (41-47), wherein a segment in said grid (5) comprises an LED strip, and wherein a target (9) is defined and highlighted by lighting segments of said grid (5) so as to highlight the contour of an area on said protective impact layer (4).
3. The training system (1) of any one of the preceding claims, comprising a plurality of wall arrangements (2.1, 2.2, 2.3, 2.4), wherein said wall arrangements are connected via a wireless communication module, and wherein, for any particular exercise to be conducted, any wall arrangement can be positioned and/or oriented on an exercising ground independently from the position and/or orientation of any other one of said plurality of wall arrangements.
4. The training system (1) of any one of the preceding claims, comprising a portable computing device (22), wherein said portable computing device (21) is configured to communicate via a wireless connection (21) with said control unit (20), and wherein said port-

able computing device (22) comprises an interface for a user (23).

5. The training system (1) of claim 4, wherein said control unit (20) comprises software entities related to different exercise options, and wherein said interface enables said user (23) to select and start a particular exercise option.
6. The training system (1) of any one of the preceding claims, wherein said control unit (20) is configured to cause lighting of light sources so as to highlight a target (9) on said wall structure (3), and/or to highlight a sequence of different targets of said wall structure (3).
7. The training system (1) of any one of the preceding claims, wherein said wall arrangement (2) comprises a support structure (11) for stabilizing the wall structure (3) on the ground, said support structure (11) being attached laterally or at the rear side (13) on said wall structure (3) and/or extending away from the rear side (13) of said wall structure (3).
8. The training system (1) of any one of the preceding claims, comprising a support structure (11) for stabilizing the wall structure (3) on the ground, wherein said wall structure (3) is height-adjustably connected to said support structure (11).
9. The training system (1) of any one of the preceding claims, comprising one or more a support structure (11, 11a, 11b), wherein each of said support structures (11) comprises a plurality of struts (14a-14c), said plurality of struts comprising a vertical or main strut (14a) at which said wall structure is fixed and a horizontal strut (14b) extending from the bottom end of the vertical strut (14a) horizontally away from a rear side of the along a ground on which the wall structure is placed.
10. The training system (1) of any one of the preceding claims, which is configured to conduct an exercise implying a single wall arrangement (2.1) and to conduct another exercise involving several wall arrangements (2.1-2.4; 2.1'-2.4'), wherein, in an exercise involving several wall arrangements (2.1-2.4; 2.1'-2.4'), one or more targets (9) on any one of said several wall arrangements (2.1-2.4; 2.1'-2.4') may be highlighted.
11. The training system (1) of any one of the preceding claims, wherein said control unit (20) comprises a memory unit on which data related to exercises and to the input from said sound sensors are stored by said control unit (20).
12. The training system (1) of any one of the preceding

- claims, comprising light sources (41-47) arranged to indicate and/or highlight a particular target (9e; 9b, 10b) to be the target to be hit by a ball, and/or wherein said light sources (41-47) are configured and/or arranged to be used as a display for displaying one or more selected from numbers, letters, words, symbols or a parameter related to a result of an exercise and/or particular ball hit. 5
- 13.** The training system of any one of the preceding claims, wherein said rigid support layer (6) comprises grooves (6) in which LED strips (5) are provided, and/or wherein said protective impact layer (4) is transparent or translucent to light produced by LEDs of said led strips (4). 10 15
- 14.** The training system (1) of any one of the preceding claims, wherein said wall structure (3) is a first wall structure (3.1), wherein said first wall structure comprises means for connecting a second wall structure (3.2) on top of said first wall structure (3.1) and/or at the left or right lateral side of said first wall structure (3.1). 20
- 15.** The training system (1) of any one of the preceding claims, comprising a RFID system (49.1-49.4, 54), wherein the wall arrangement (2) comprises a RFID reader (49.1), configured to communicate with a portable RFID tag (54), wherein the RFID tag can be carried by a player (39). 25 30
- 16.** The training system (1) of any one of the preceding claims, comprising a support structure (11) for stabilizing the wall structure (3) on the ground, wherein said support structure (11) comprises a detachable, portable weight-providing element (16), said element being preferably a water tank. 35
- 17.** The training system (1) of any one of the preceding claims, wherein said wall structure (3) comprises a rigidifying plastic board (24) comprising a rigid cellular plastic. 40
- 18.** The training system (1) of claim 19, wherein said rigid cellular plastic comprises honeycomb structured cells. 45
- 19.** The training system (1) of any one of the preceding claims, wherein said wall arrangement (2) comprises a support structure (11) at which said wall structure (3) is connected, wherein said support structure comprises a rail (15) and wherein said wall structure (11) is arranged to be guided in said rail (15) and comprises attachment means for blocking the wall structure (11) at a selected position along said rail (15). 50 55

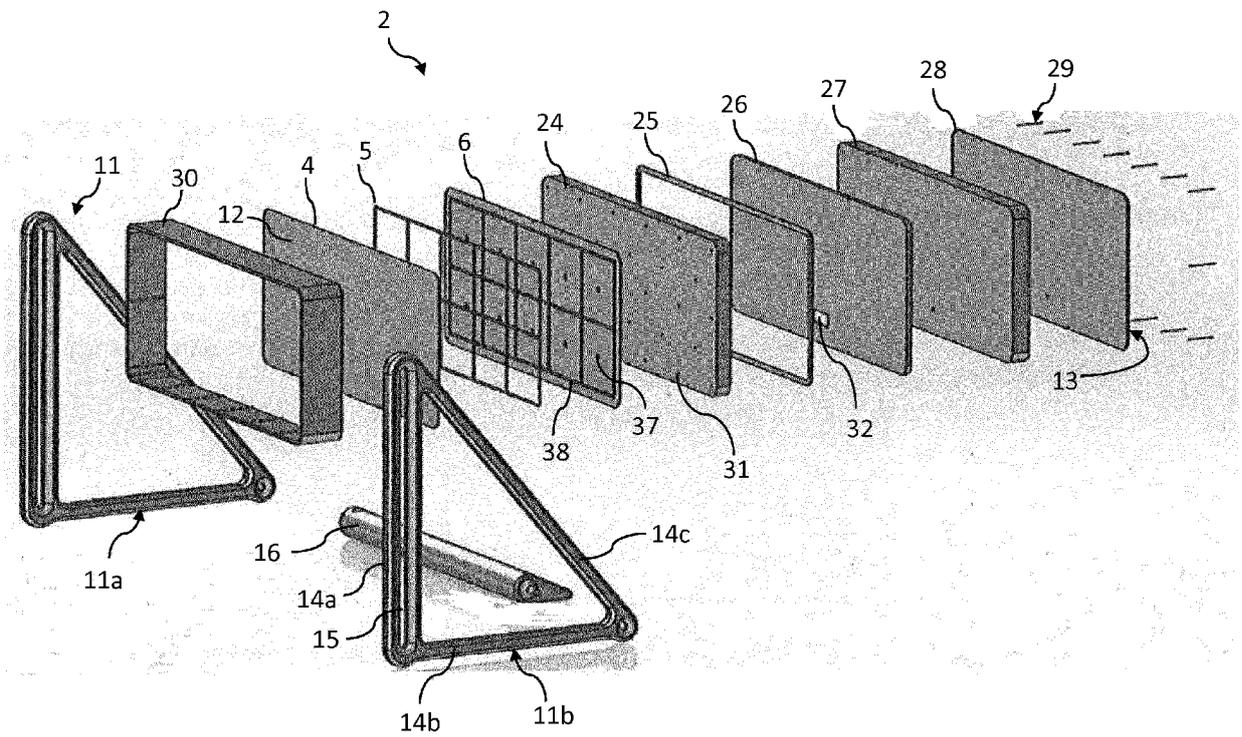


Figure 1 B

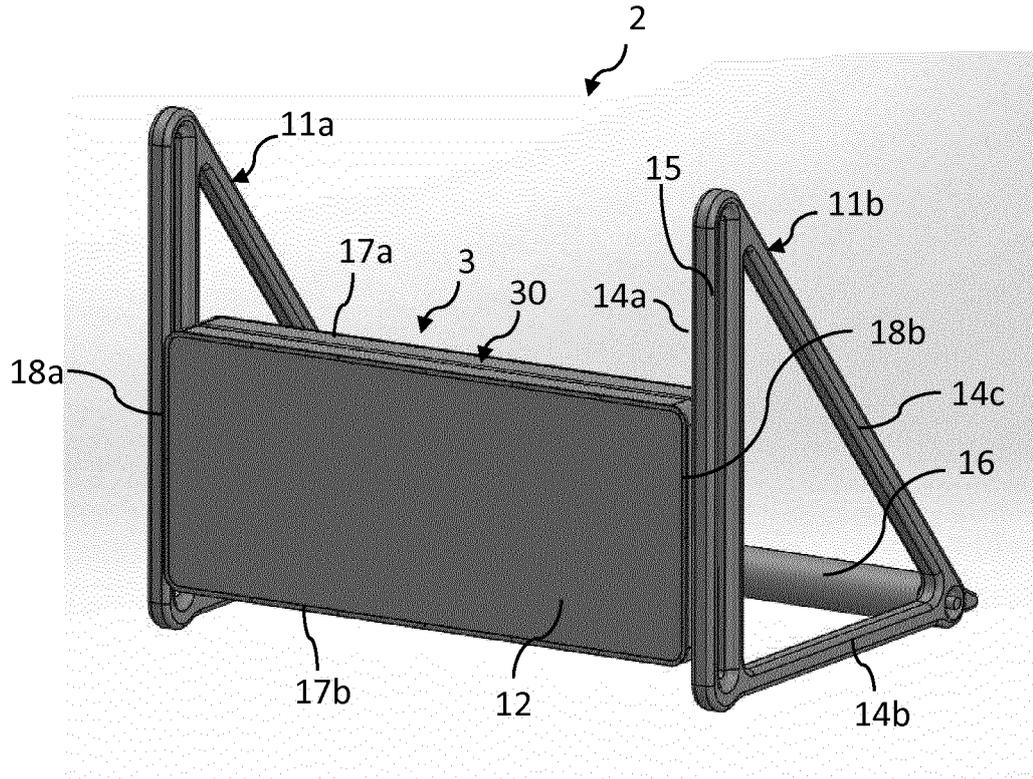


Figure 1 A

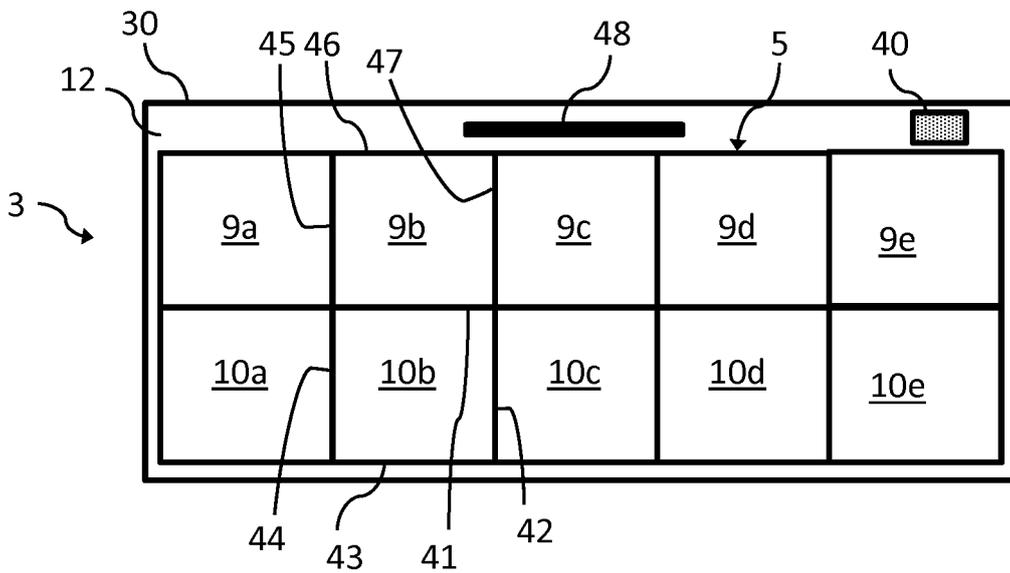


Figure 2 A

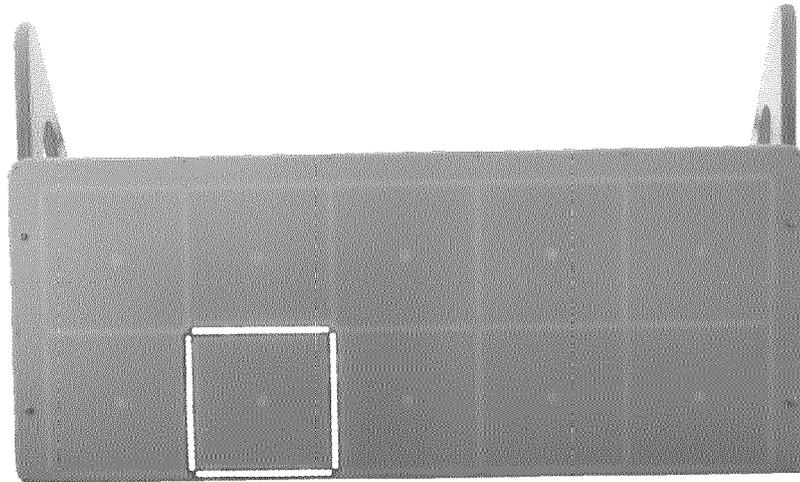


Figure 2 B

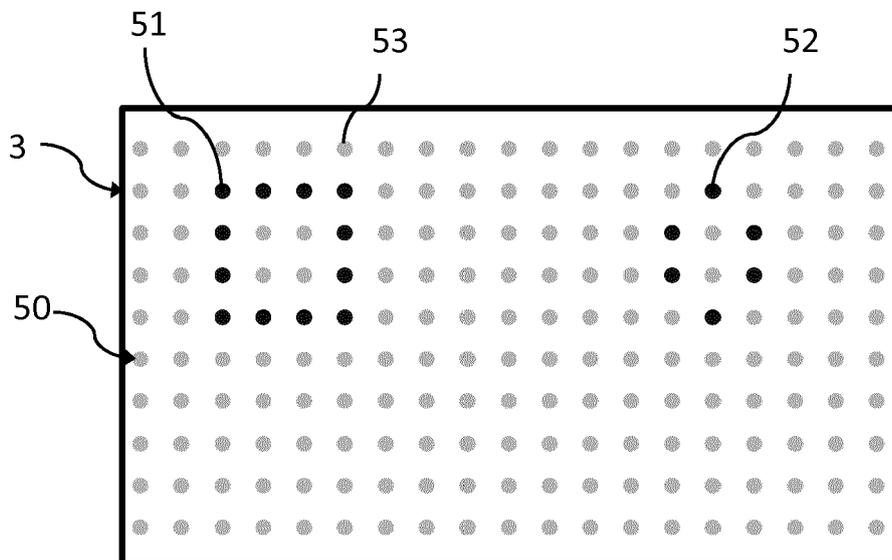


Figure 2 C

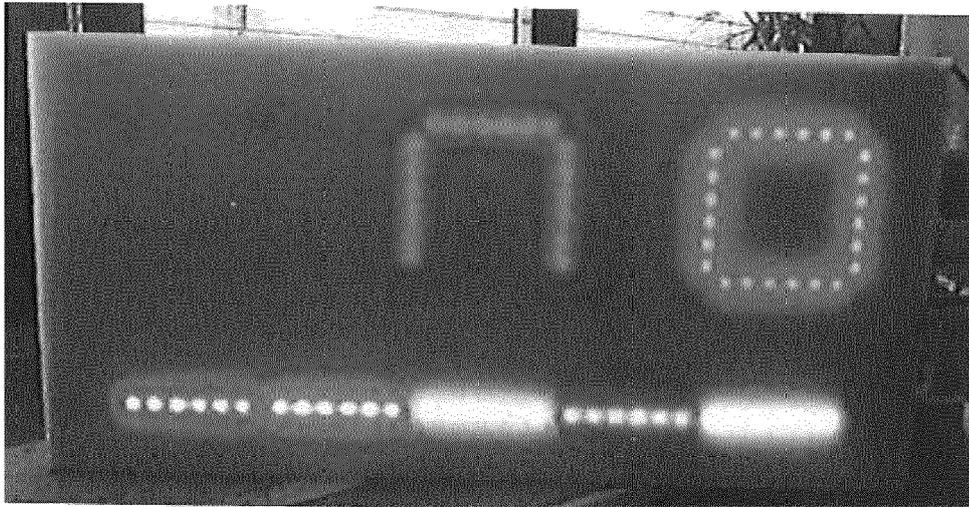


Figure 3

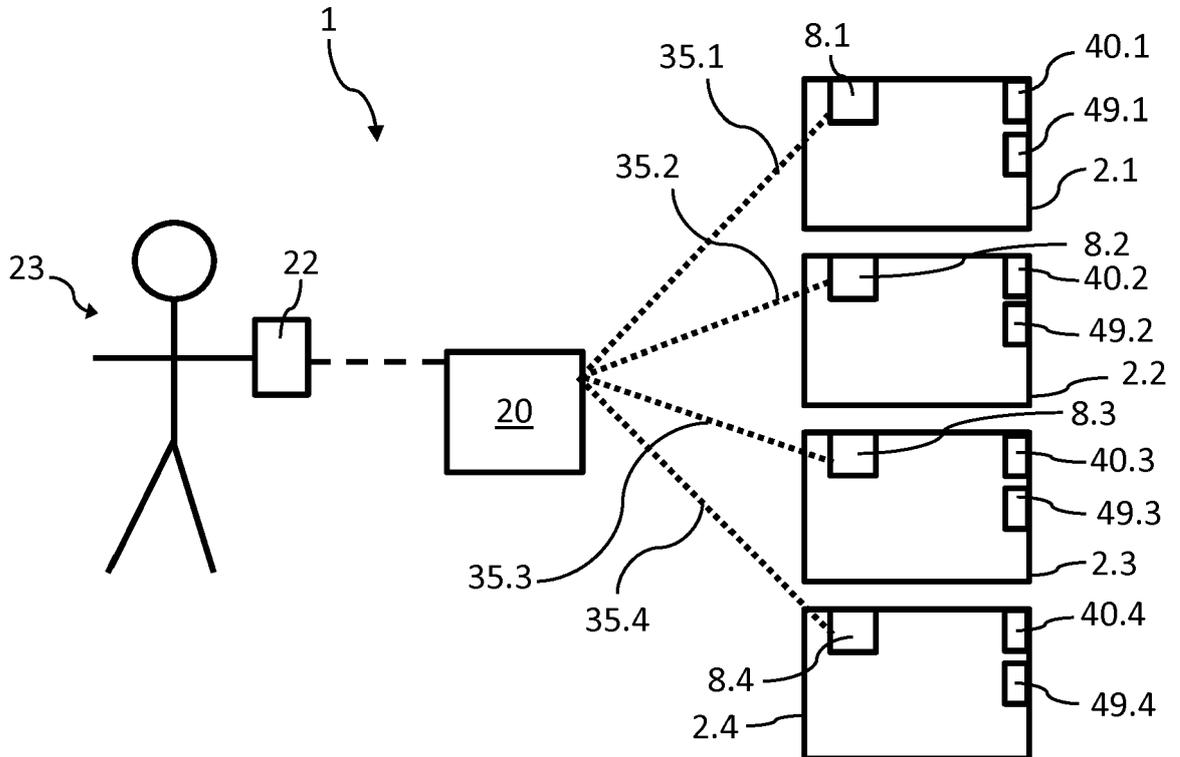


Figure 4 A

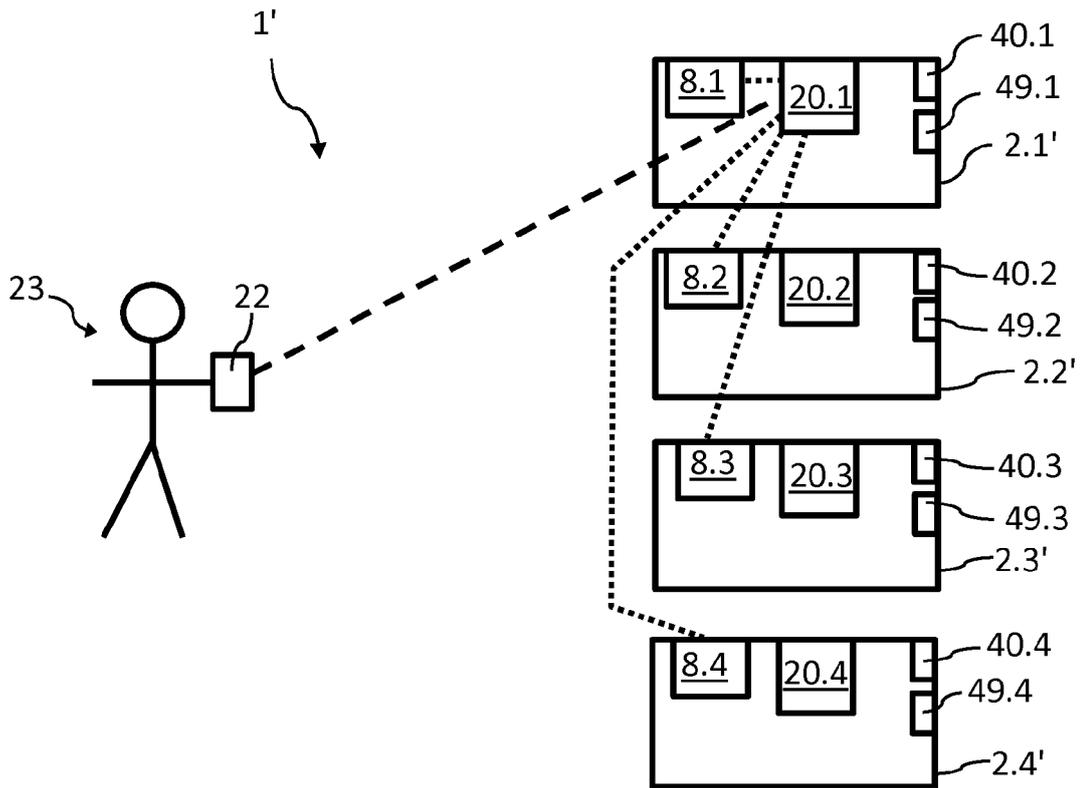


Figure 4 B

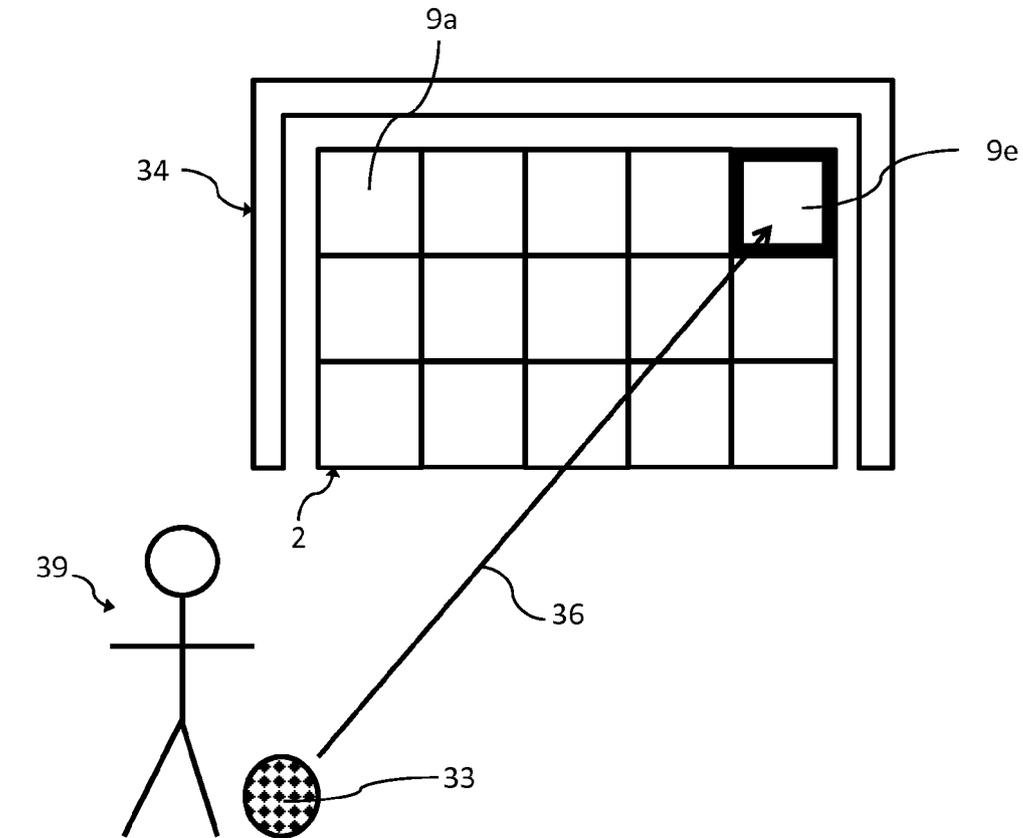


Figure 5 A

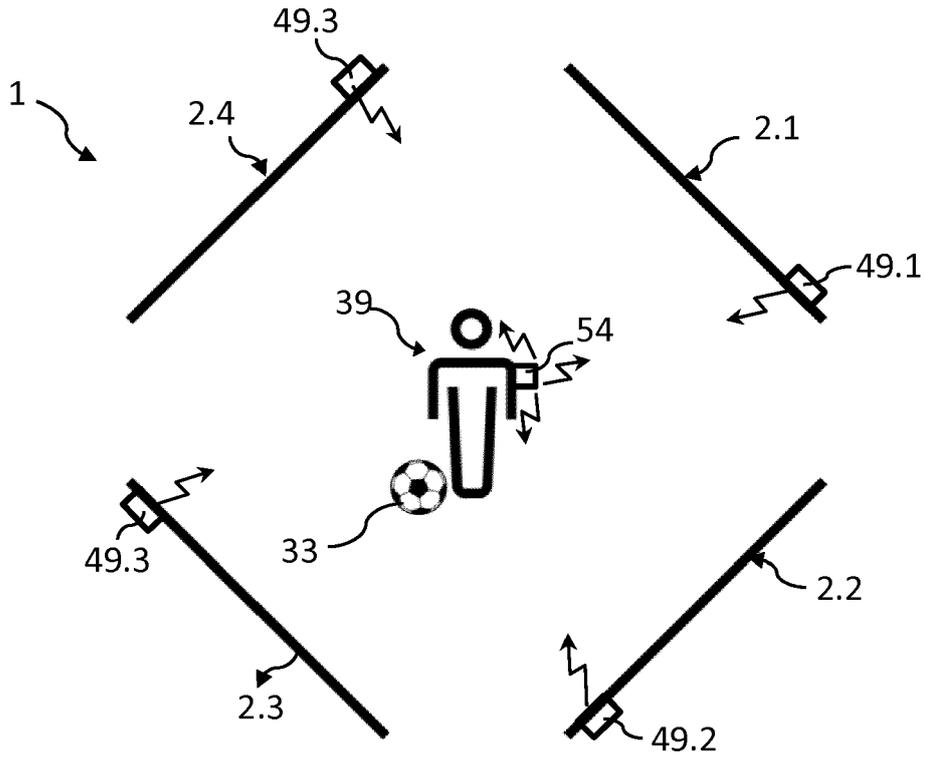


Figure 5 B

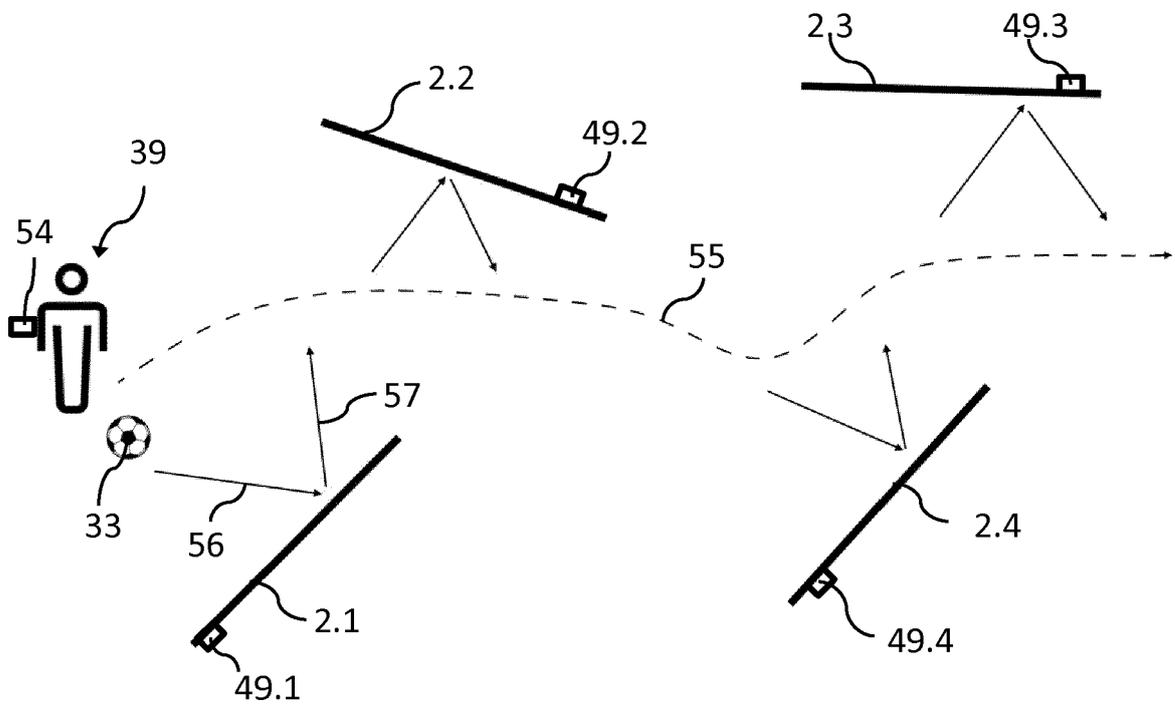


Figure 5 C



EUROPEAN SEARCH REPORT

Application Number  
EP 15 17 6669

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DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X	EP 0 083 316 A1 (MARCHESINI MANLIO [IT]; CAPORALI GIANCARLO [IT]) 6 July 1983 (1983-07-06) * page 3, line 16 - page 7, line 15; figures 1-3 *	1,6,7,12	INV. A63B69/00 A63B71/06 A63B24/00 H04M1/725
X	US 6 575 851 B1 (LAMBERTI CATHERINE B [US] ET AL) 10 June 2003 (2003-06-10) * column 2, line 24 - column 6, line 14; figures 1-5 *	1-7,9, 10,12-15	
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