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(54) **ADVANCED SYSTEM FOR PHYSICAL CONDITIONING AND SPORTS TRAINING**

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(57) **ABSTRACT**

The present disclosure provides a system for conditioning and training, generally comprising a floor portion and at least one guide within a line of sight of the floor portion. The guide is configured to display training programs for a user to use to improve sports skills, such as hockey skills for example. In an embodiment, the floor portion has RFID tags to determine where a puck or other object is located. In another embodiment, the system has an apparatus to determine, verify or display a puck location. The apparatus can be either a camera or an AR unit such as glasses. Based on information provided and received, the system can tailor exercises for a user and provide enhanced statistics to improve skills.

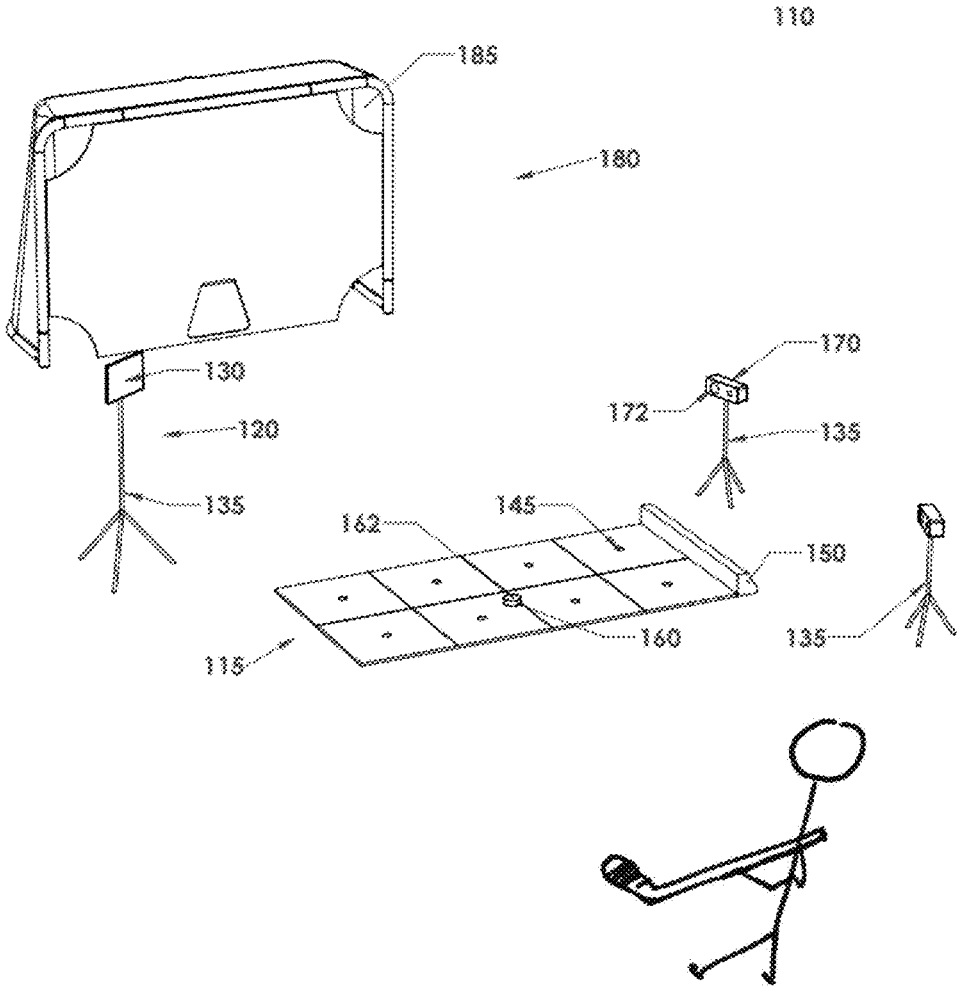


FIGURE 1

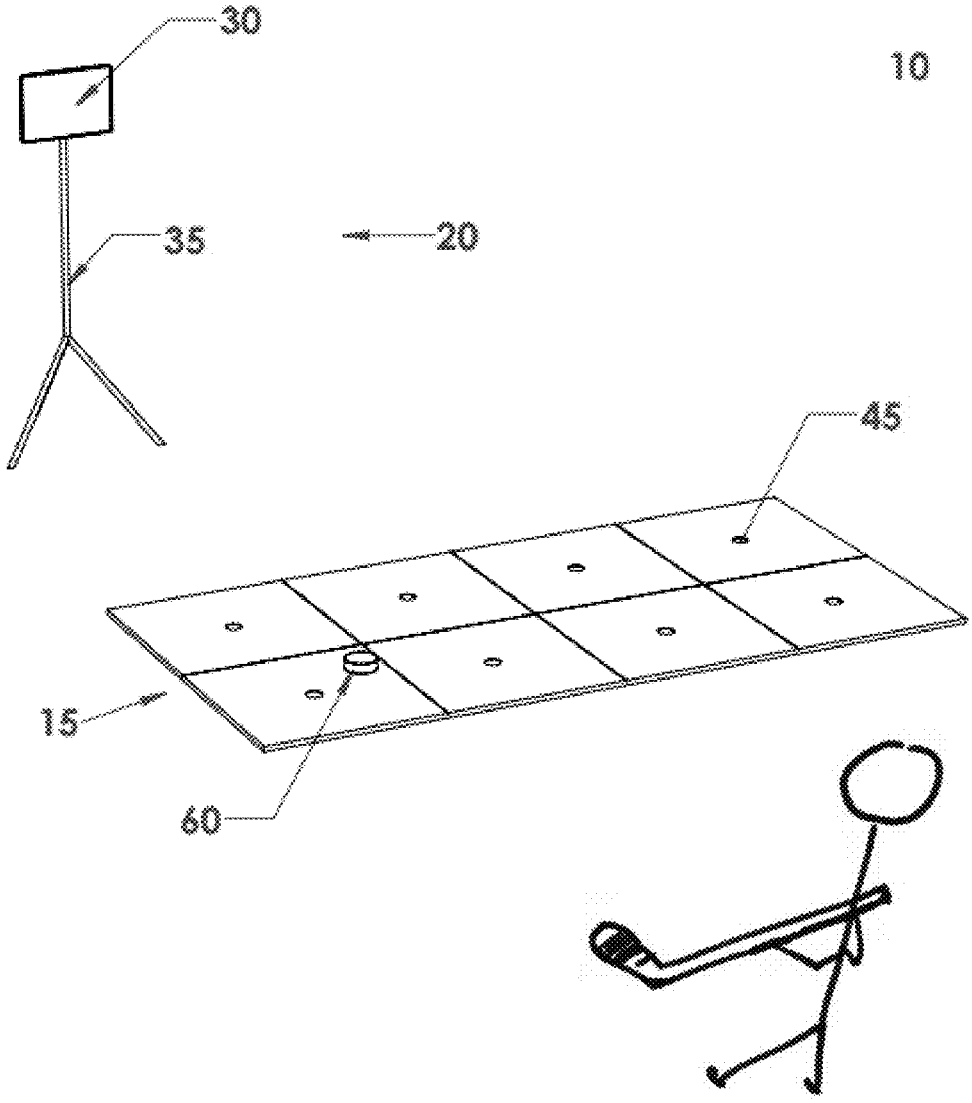


FIGURE 1A

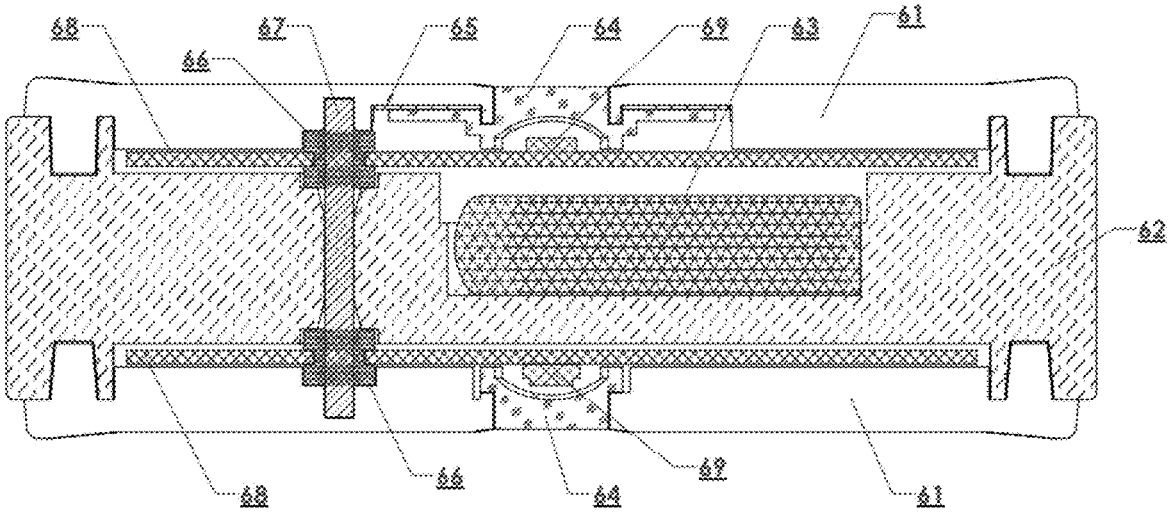


FIGURE 2

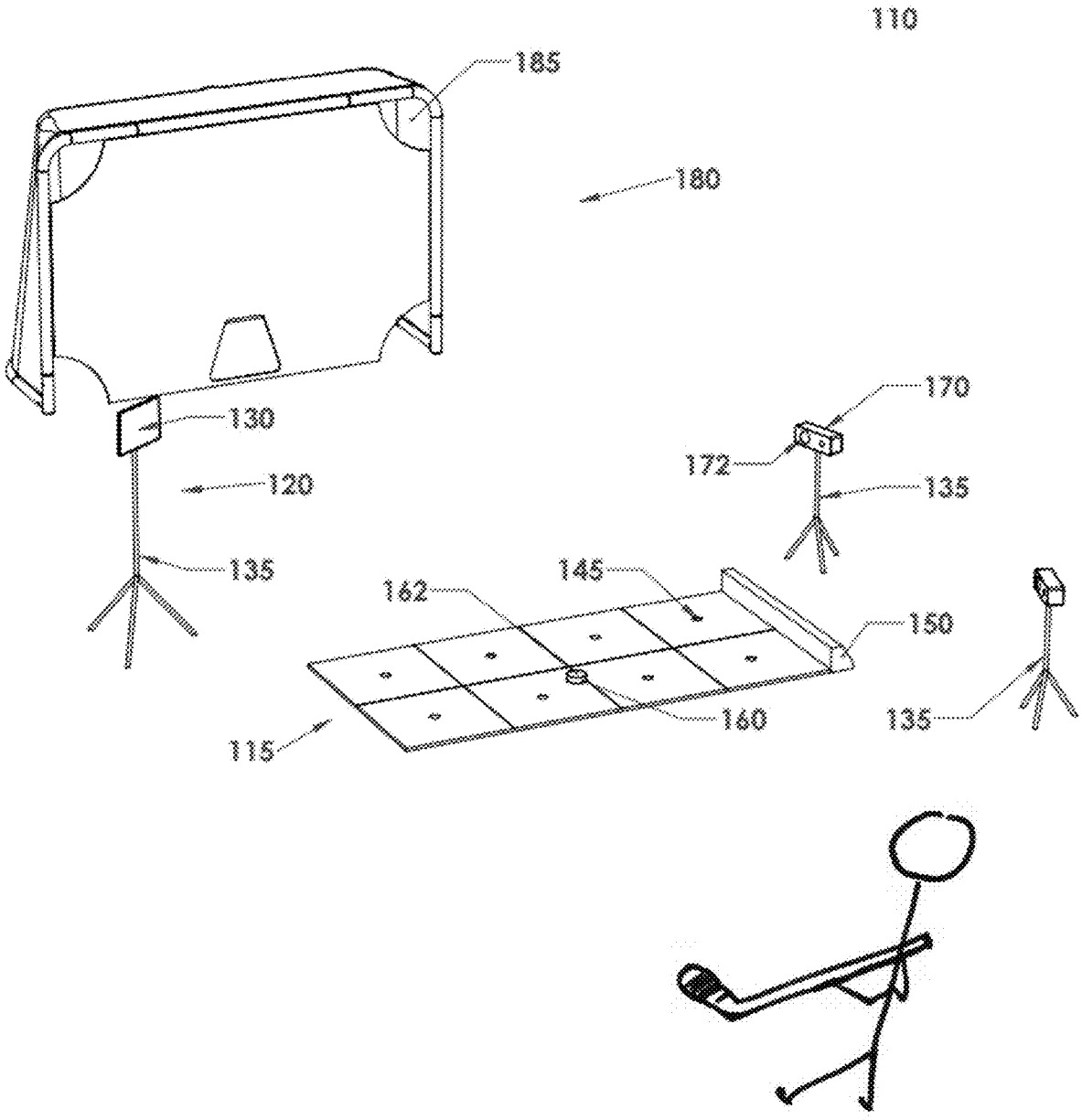


FIGURE 3

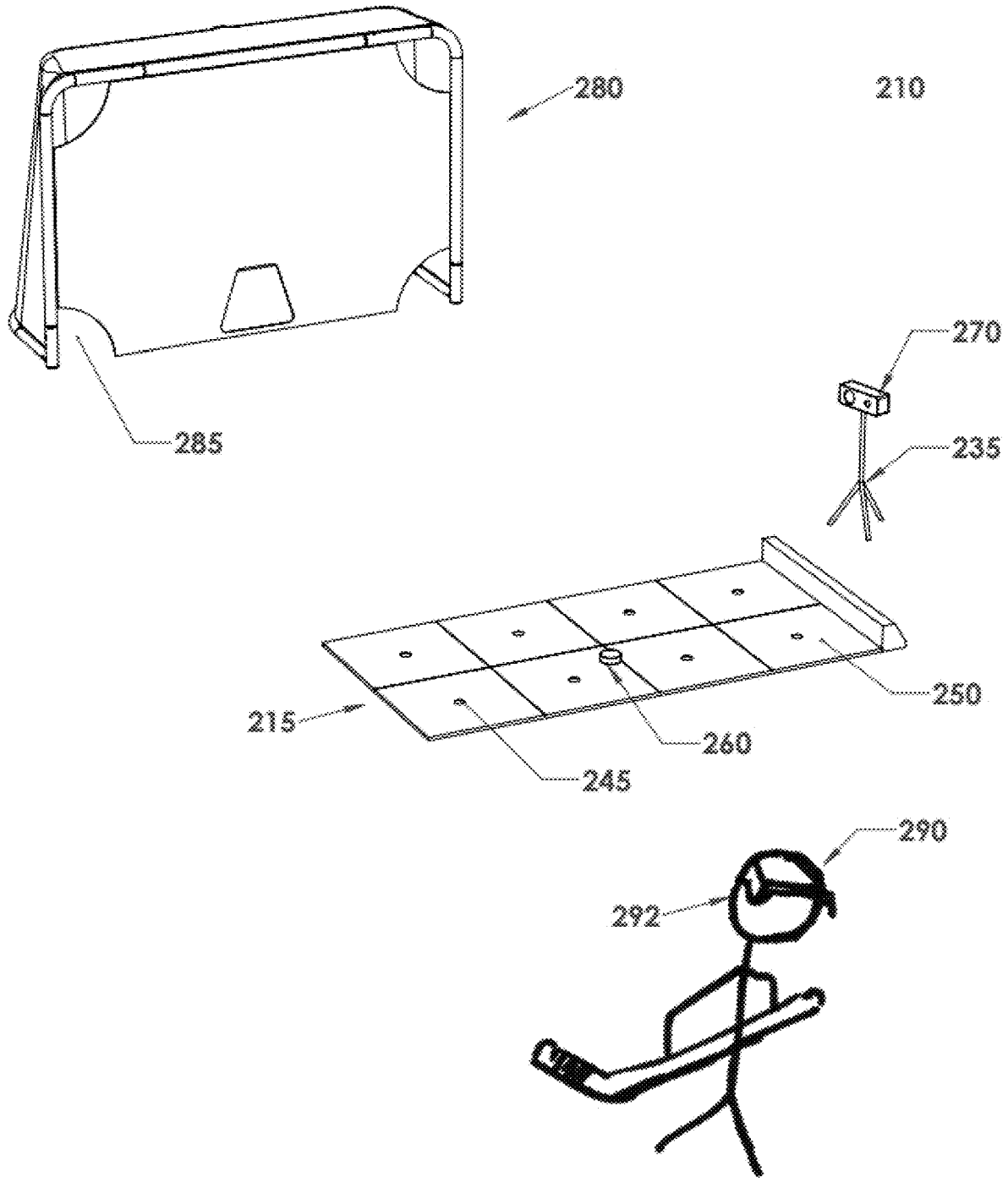


FIGURE 4A

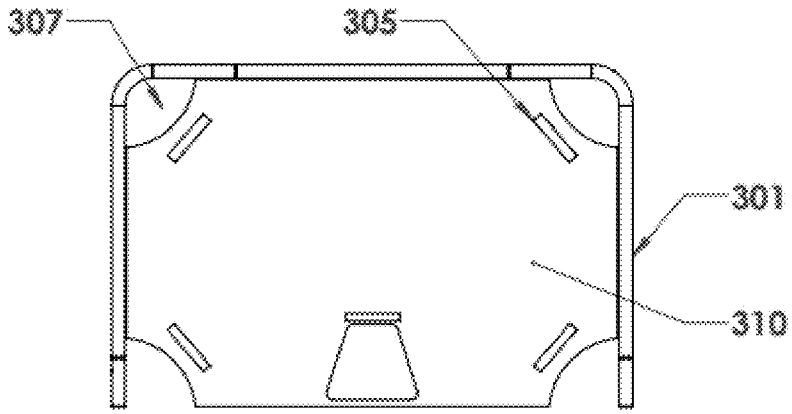


FIGURE 4B

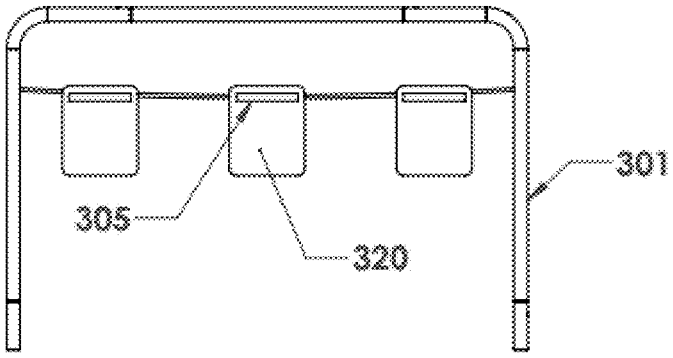
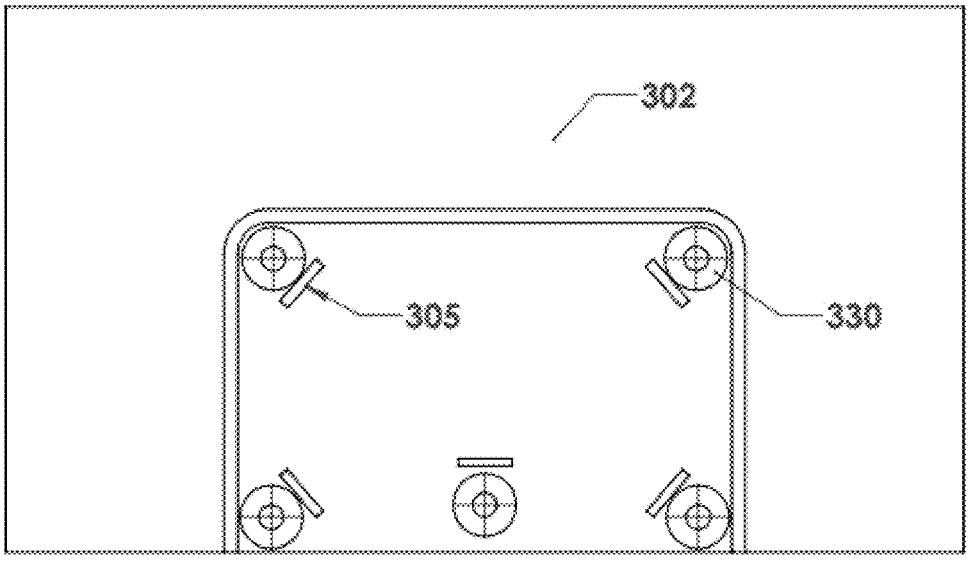


FIGURE 4C



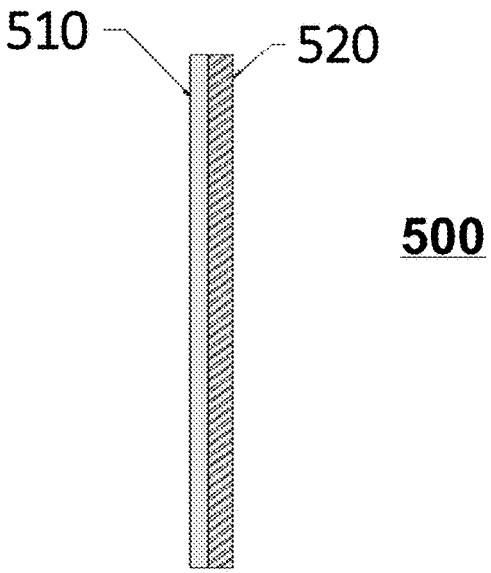


FIGURE 5A

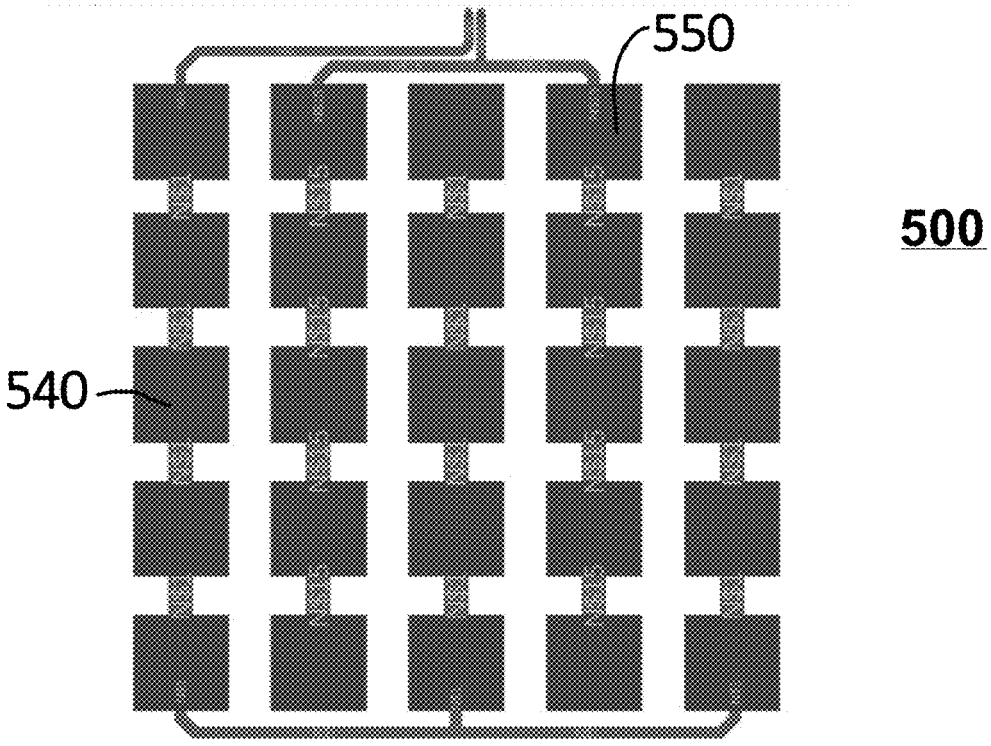


FIGURE 5B

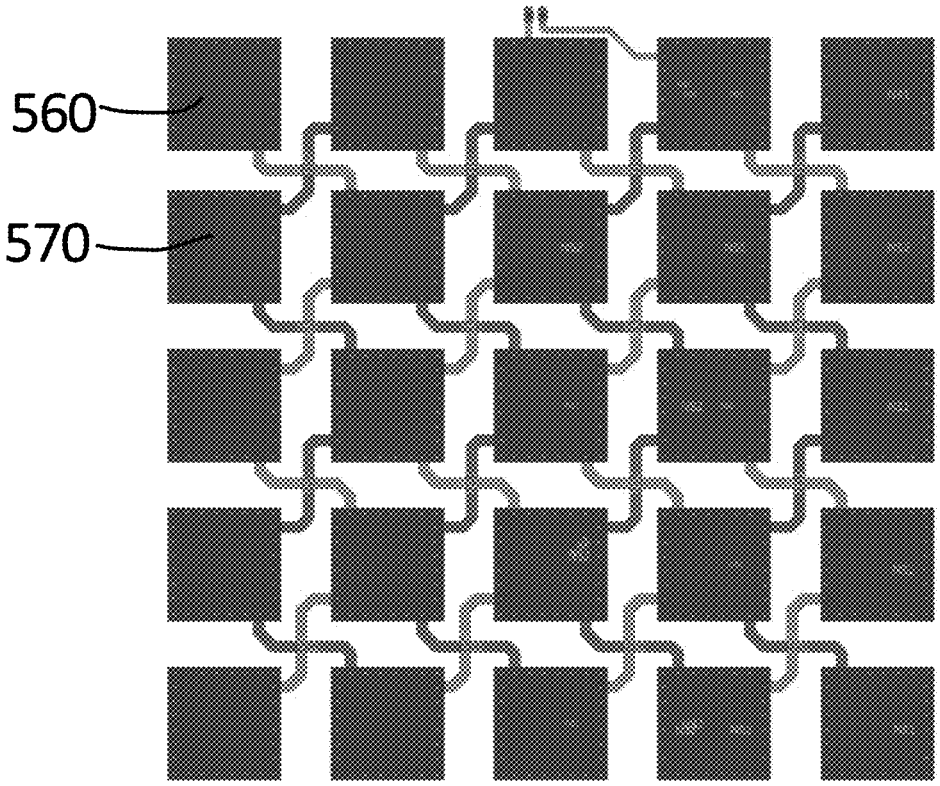


FIGURE 5C

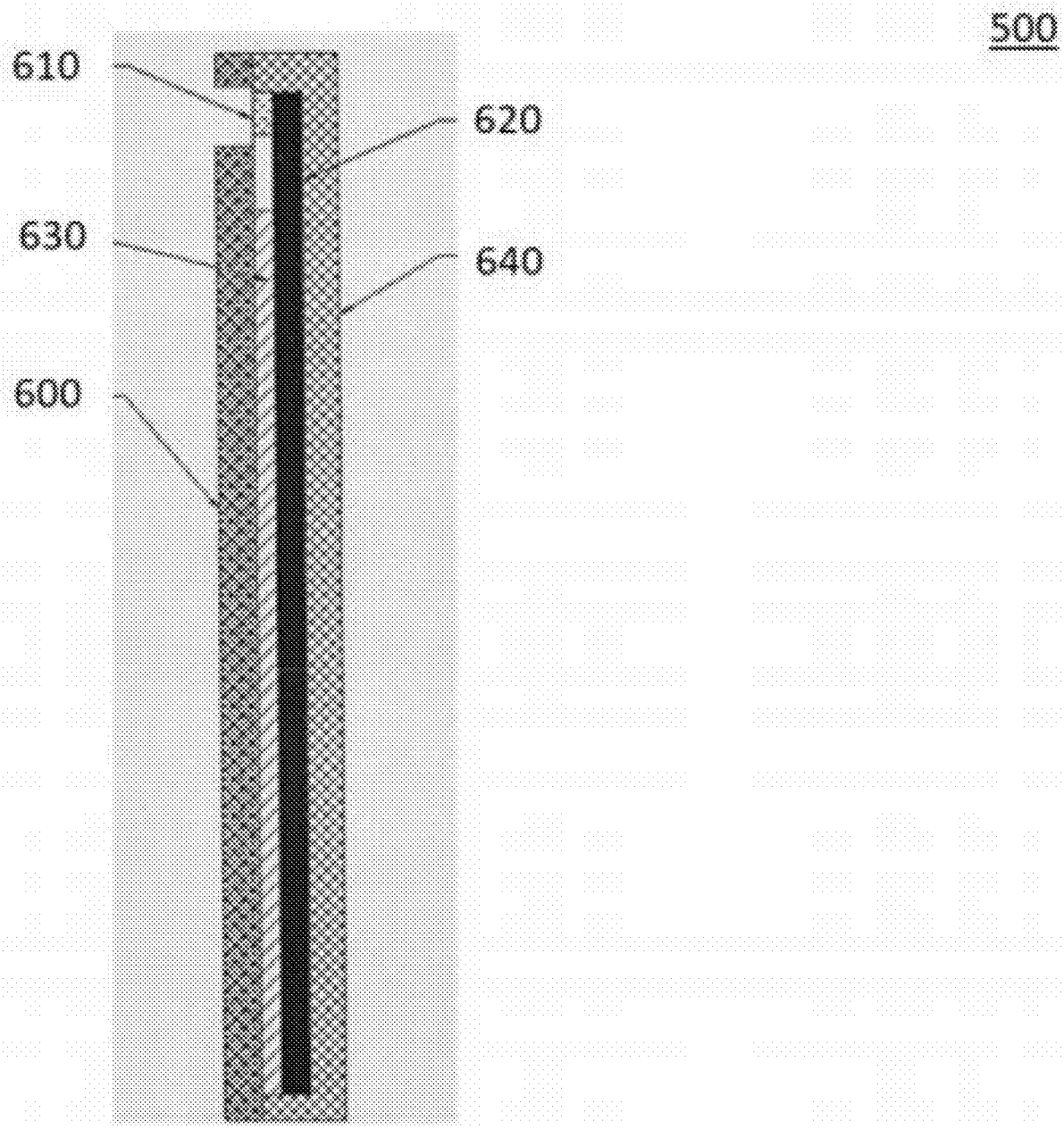


Figure 5D

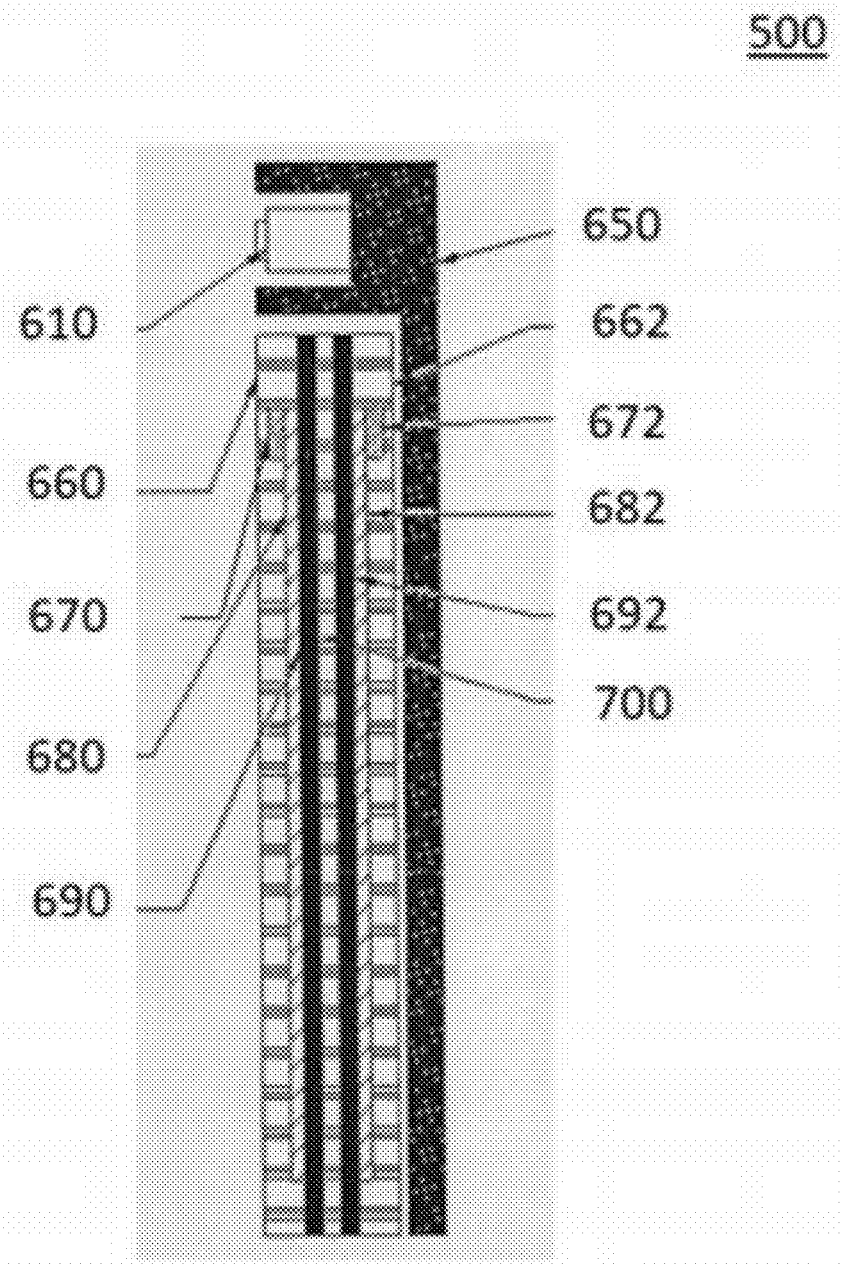


Figure 5E

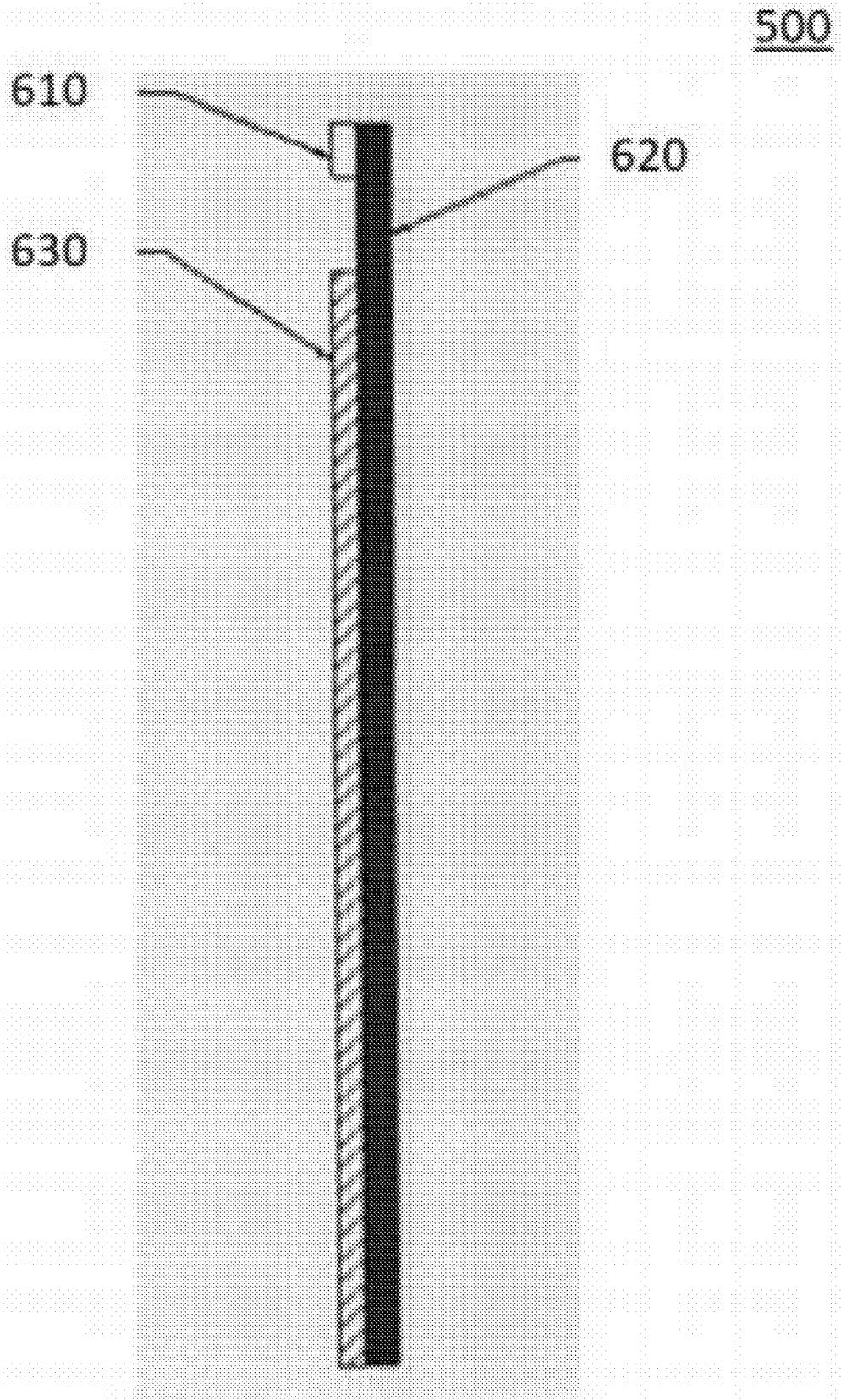


Figure 5F

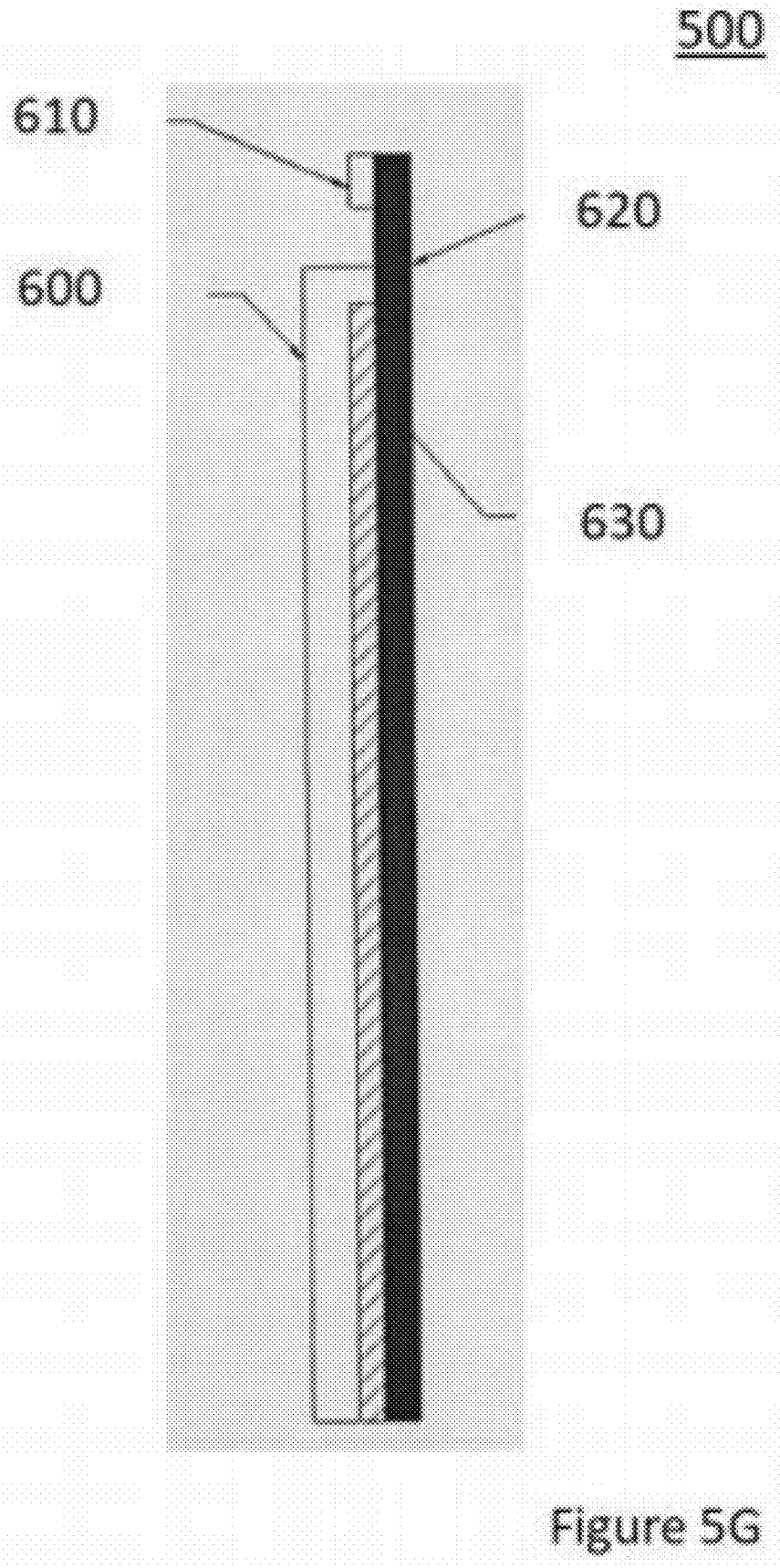


Figure 5G

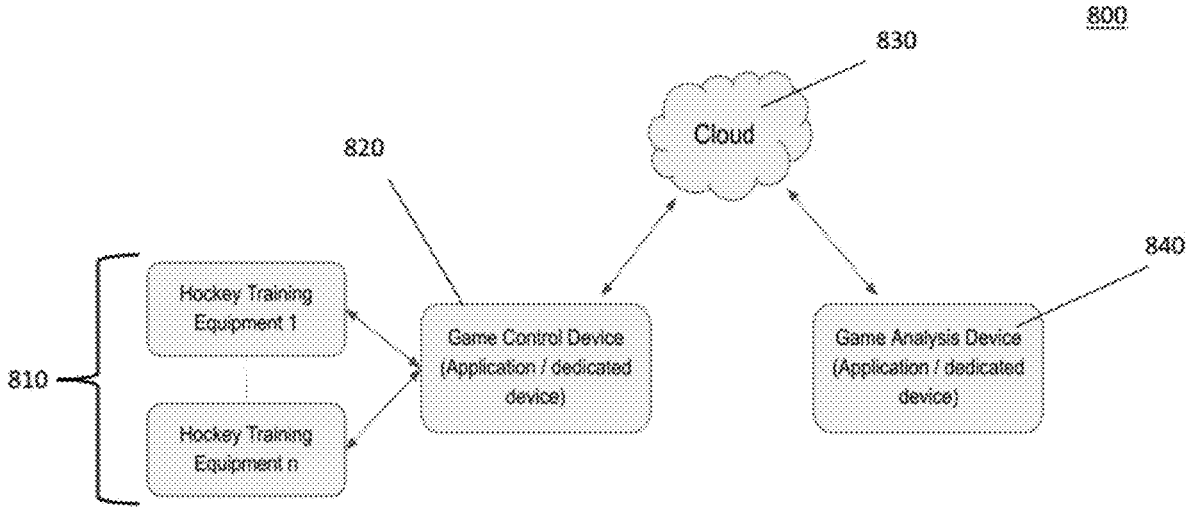

800
830
Cloud
820
840
Hockey Training Equipment 1
Hockey Training Equipment n
810
Game Control Device (Application / dedicated device)
Game Analysis Device (Application / dedicated device)

Figure 6

ADVANCED SYSTEM FOR PHYSICAL CONDITIONING AND SPORTS TRAINING

CROSS REFERENCE TO RELATED APPLICATION

[0001] The present application claims priority to U.S. Provisional Application No. 63/068,699, entitled "Advanced System for Physical Conditioning and Sports Training" filed on Aug. 21, 2020, the contents of which are incorporated herein by reference in their entirety.

FIELD

[0002] The disclosure relates to the field of training, and more specifically to an advanced interactive system for physical conditioning and sports training.

SUMMARY

[0003] In an aspect, the present disclosure provides a system for conditioning and training comprising: a floor portion further comprised of a plurality of radio-frequency identification (RFID) tags; and, at least one guide in within a line of sight from the floor portion, wherein the system displays instructions on the at least one guide and determines a correct position of an object on the floor portion, and wherein data is generated to improve conditioning and training an operator.

[0004] In another aspect, the present disclosure provides a system for conditioning and training comprising: at least one guide in within a line of sight from a surface area; and, at least one apparatus, wherein the system displays instructions on the at least one guide and the at least one apparatus determines a correct position of at least one object on the surface area, and wherein data is generated to improve conditioning and training an operator.

[0005] From a very broad point of view this system works as follow: first, an instruction is given to the player via screen such as a tablet, mobile or via voice command and the user then tries to recreate/follow the said instruction as quickly as possible and/or as accurately as possible. The system is then able to track the movement and location of the puck (or other) and analyze the users' performance. Scoring and points can be recorded to gamify the training and to enable the user to see an improvement in performance. On top of being able to record the user performance, the system is using AI technology to further recommend or adjust the training routines of the user based on the data patterns available so as to target training to areas of improvement. There is also means for the system to share the scoring with other users via an online platform. With the online platform, the user has a means to compare their performance with other individuals from the same age group but also can provide those numbers to trainers that can further help the user in developing specific skills. There are two different categories of training that are available to choose from. The first type of training is game-like, where precision is not necessarily required but it will help the player to build up his speed, stickhandling, heads up capability and his confidence overall. In the other type of training, puck placement precision is important, as well as the speed at which the puck is being moved. In this case, the training is meant to be less of a game and more geared towards actual performance from the athlete. Here, the data analytics will help players and coach to improve specific skill and also, in some extent, be able to compare various players in different skill area of the game. Over time, the player will be able to track their improvements, which, with some help of statistical analysis, could even help forecast what performance can be expected in the future.

[0006] Stickhandling, puck control, speed and precision of puck placement are the three main aspects the systems described herein are recording and analyzing. In shooting, the puck speed and the accuracy are the main components recorded. Here, the systems record the amount of shots taken, the amount of target hit and the time spent between the moment the signal was given and the target being hit to evaluate what the reaction time of the user is. Passing is another aspect that may be recorded, where the puck placement and speed would be analyzed.

[0007] In accordance with the present embodiment, there is a puck comprising of an RFID antenna used to detect passive RFID tags placed throughout the training area on top of the tiles used to confirm the position of the puck on the surface. The puck may also have a microprocessor and wireless transmitter to allow the puck to send data from the RFID reader and/or other sensors on the device wirelessly. A software application running on a device with computing capabilities, such as a tablet, mobile phone or even dedicated computer, receives the data from the puck analyses it and further incorporates it in an advanced training application. It should also be noted that the opposite is also possible, where the RFID readers are located within or under the surface and the RFID tag is moving with the puck.

[0008] This application can display to the user where to locate the puck on the training surface. Furthermore, the application can recognize the user's weaknesses in implementing a training pattern that will help overcome the said weakness. This application may also analyze which stickhandling patterns the players have difficulty with and suggests certain patterns and other advice to help the player improve their skills.

[0009] In another embodiment, there is a device that includes a camera or multiple cameras that oversee the training surface and are able to send the data via wireless means to a software running on an electronic device that can follow the movement of the puck. This application can compare the movement of the puck with the training instructions given to the user and adjust the training instructions according to weaknesses detected during the said training. This system is particularly advantageous, as it does not require the user to use a puck filled with electronics, allowing the user to practice shooting skills using multiple pucks, as they would normally do. It is noted that an infrared camera could be used to help track the puck movement if the puck is equipped with a small infrared light or reflector on both sides.

[0010] In another embodiment, not only there is a camera used to track the movement of the puck but the user is also wearing glasses that are equipped with augmented reality (AR) technology that allows the user to see, in real time, training instructions without having to look at a screen. Those glasses are connected to a computer that analyzes the data from the camera and the software then provide up-to-date score and tips to help further the player.

[0011] In another embodiment where the player is training for shooting accuracy, some targets are placed in front of a net or another surface and lights are used to indicate which target the player should aim for. Using video technology or

other type of technology, the system can detect if an attempt was made to hit the target and if the target was indeed hit. This allows for the software to then analyze not only how long it took for the player to hit certain target but how many attempts it took and adjust the training in the future in a way that help the user to improve in the areas where those weaknesses were detected.

BRIEF DESCRIPTION OF THE DRAWINGS

[0012] The following figures serve to illustrate various embodiments of features of the disclosure. These figures are illustrative and are not intended to be limiting.

[0013] FIG. **1** is a perspective view of a system for physical conditioning and sports training using RFID technology to confirm puck location on a training surface, according to an embodiment of the present disclosure;

[0014] FIG. **1**A is a cross-section view of a puck for use in the present system, according to an embodiment of the present disclosure.

[0015] FIG. **2** is a perspective view of a system for physical conditioning and sports training using machine vision technology to confirm puck location on a training surface, according to an embodiment of the present disclosure;

[0016] FIG. **3** is a perspective view of a system for physical conditioning and sports training using machine vision technology to confirm puck location on a training surface and provide instructions to a user using AR technology-equipped glasses, according to an embodiment of the present disclosure;

[0017] FIG. **4**A is a front view of a goal covered with a training tarp where the targets are openings, according to another embodiment of the present disclosure;

[0018] FIG. **4**B is a front view of a goal having three strung up targets, according to another embodiment of the present disclosure; and,

[0019] FIG. **4**C is a front view of a training tarp having illustrated goals and targets, according to yet another embodiment of the present disclosure;

[0020] FIG. **5**A is a cross sectional view of a target for use in the present system according to one embodiment of the present invention;

[0021] FIG. **5**B is a single layer printed circuit board (PCB) used in a target according to one embodiment of the present invention;

[0022] FIG. **5**C is two-layer printed circuit board (PCB) layout used in a target according to one embodiment of the present invention;

[0023] FIG. **5**D is a cross-section of a target for use in the present system according to one embodiment of the present invention;

[0024] FIG. **5**E is a cross-section of another target for use in the present system according to one embodiment of the present invention;

[0025] FIG. **5**F is a cross-section of another target for use in the present system according to one embodiment of the present invention;

[0026] FIG. **5**G is a cross-section of another target for use in the present system according to one embodiment of the present invention; and

[0027] FIG. **6** is a flow chart showing data being transmitted over a network.

DETAILED DESCRIPTION

[0028] The following embodiments are merely illustrative and are not intended to be limiting. It will be appreciated that various modifications and/or alterations to the embodiments described herein may be made without departing from the disclosure and any modifications and/or alterations are within the scope of the contemplated disclosure.

[0029] With reference to FIG. **1** and according to an embodiment of the present disclosure, a system for physical conditioning and sports training **10** is shown, preferably comprised of a floor portion **15** and at least one guide **20** positioned within a line of sight of the floor portion **15**. A worker skilled in the art would appreciate that the system **10** is preferably used to practice hockey stickhandling. Indeed, the system **10** helps a user develop excellent stickhandling skills by practicing heads-up, peripheral view feel of an object such as a puck **60** on stick blade, sensing of puck **60** location/movement during stickhandling, memory recall of locations for stickhandling and quick eye drop to adjust the puck on stick blade. The guides **20** are generally comprised of a front display unit **30** that is mounted on a stand such as a tripod **35**. The instructing devices are preferably equipped to transmit and receive data over a WiFi or other wireless network, such that the guide **20** may receive training modules to properly display specific training exercises from an operator, or send training data to the operator. In a preferred embodiment, the front display unit **30** is a screen such as an LED or LCD screen, capable of displaying a variety of graphics, lights, sounds to assist an operator when using the system **10**. In this particular embodiment, the display unit **30** is a mobile tablet. The display unit **30** is also running a software (app) to send and receive the aforementioned data from an operator and puck **60** and actuate the screen to provide instructions to move the puck **60** on the floor portion **15** and over the markers **45** in specific sequences. In a preferred embodiment, the markers **45** are RFID passive labels or IR reflective stickers. The puck **60** is equipped with a RFID reader or an IR receiver that would detect if the puck **60** went to the correct location and transmit back the data to the unit **30** for scoring purposes. The puck would also have the following components (Microcontroller, Battery, BLE and/or wifi modules) to make it a "SMART PUCK" that can then be used for training with multiple products.

[0030] With reference to FIG. **1**A and according to one embodiment of the present invention, a cross-section of a puck **60** used in the present invention is shown. The components of puck **60** are comprised of two gliding surfaces **61** which are located on the top and bottom surfaces of puck **60**. Puck **60** has a core **62** made of an energy-absorbing elastomer and a battery **63** secured within core **62**. Puck **60** further comprises printed circuit boards PCB **68**, each sandwiched between core **62** and surfaces **61**. Here, the PCBs **68** have a small light (LED) **69** that can be used to verify the various status of the device. Both surfaces **61** have a transparent opening **64** allowing a user to view light **69**. The PCBs **68**, core **62** and surfaces **61** are assembled through the use of axial pins **67**. It is also preferred to use a grommet **66** to further prevent damage to the PCBs **68** during use. A worker skilled in the relevant art would be familiar with the use of components allowing to secure PCB **68** within a puck and such knowledge would not be limited to a grommet.

[0031] With further reference to FIG. **1**A and according to one embodiment of the present invention, a first PCB **68** incorporates the main locating sensor (whether it be IR,

RFID, or other), processing and communication antenna and the second PCB **68** provides the power management aspect for puck **60**. In another embodiment, puck **60** could consist of a single PCB **68** which provides all functions of puck **60** for example, power management, puck location, processing and communicating with unit **30** as described in FIG. **1**.

[0032] With further reference to FIG. **1** and according to one embodiment of the present invention, guides **20** must also remain within line of sight of the floor portion **15**, as a user needs to see them to know which exercise to perform. Although eight markers **45** are shown per floor portion **15**, a preferred range is between four and twelve markers **45**. Having a variety of markers **45** in different sizes and colors to provide a user with the ability to perform complex shooting and stickhandling moves is an advantage of the system **10**. In another embodiment where the floor portion **15** is much larger, the markers **45** could also be located on cones, rebounding apparatus, dummies, etc, without departing from the scope of the disclosure.

[0033] With reference to FIG. **2** and according to another embodiment of the present disclosure, a system for physical conditioning and sports training **110** is shown, preferably comprised of a floor portion **115**, at least one guide **130** positioned within a line of sight of the floor portion **115**, at least one camera apparatus **170** and optionally, a targeting portion **180** with targets **185**. A worker skilled in the art would appreciate that in another embodiment, the floor portion **115** is not required and an existing surface area could be used. The guides **120** have a front display unit **130** mounted on a stand **135**; however, the tracking of the puck **160** would be done using the camera apparatus **170** that includes a microcontroller and the ability to transfer data via a wired or wireless connection in conjunction with machine vision technology. Furthermore, an infrared camera **172** on module **170** and an infrared light **162** or led on each side of the puck **160** will assist in tracking the puck **160**. It is advantageous to have an infrared light **162** (or reflector) on each side of the puck so that if the puck **160** is flipped, the training can continue uninterrupted. The infrared camera helps simplify the image processing as it is only processing the infrared spectrum versus the full light spectrum visible by the human eye. Multiple camera modules **170** can be used to have a better view of the floor portion **115** and avoid losing track of the puck **160** during training session if the view is obstructed. Predictive trajectory calculation can also be used in an attempt to know where the puck **160** is located based on previous trajectory and speed if something or someone momentarily obstructs the camera's field of vision. For example, in a preferred embodiment, predictive trajectory calculation may use frames of video footage as individual, discreet photographs. Based on these photographs, a speed and trajectory can be calculated to determine where, within a certain error margin, where the puck **160** will end up on the targeting portion **180** or another receiving surface.

[0034] Another embodiment for the vision technology (camera **170**) will be in its use to determine a player's proper form while performing training and allow for a feedback loop to the player so as to improve their stance amongst various training activities.

[0035] The floor portion **115** is further comprised of markers **145** to assist a user with stickhandling drills. Indeed, the markers **145** are preferably illuminated under the floor portion **115**; however, a worker skilled in the art would appreciate that the markers **145** could be painted dots, stickers, friction rubber dots either on the top surface or underneath a transparent floor portion **115**.

[0036] With reference to FIG. **3** and according to another embodiment of the present disclosure, a system for physical conditioning and sports training **210** is shown, preferably comprised of a floor portion **215**, at least one puck **260**, glasses embedded with augmented reality (AR) technology **290** and, optionally, a passing apparatus **250**, and optionally a targeting portion **280** with targets **285**. A worker skilled in the art would appreciate that in another embodiment, the floor portion **215** is not required and an existing surface area could be used. As shown, the targeting portion **280** is a hockey net with targets **285**. The glasses **290** would have a camera **292** to register what the user sees and display instructions and information on the lens of the glasses **290** in a way that it overlays the training devices used in the vision field of the user. For example, a certain routine could have the player stickhandle by displaying flashing circles over the markers **245**, which the user would see with glasses **290**. The user would understand having to bring the puck **260** over the flashing circles. The glasses **290** may then highlight a certain target **285** on the targeting portion **280**, at which the user would understand having to shoot the puck **260** at that particular target **285**. To help locate the user's position in relation to the floor portion **215**, a camera module **270** can also be used. The floor portion **215** is further comprised of markers **245** to assist a user with stickhandling drills and help the system **210** locate itself and the objects being used. A worker skilled in the art would appreciate that the markers **245** could be painted dots, stickers, friction rubber dots either on the top surface or underneath a transparent floor portion **215**.

[0037] An advantageous feature of the systems **110** and **210** shown in FIGS. **2** and **3**, respectively, is that the systems **110**, **210** provide both stickhandling and shooting functions. The floor portion **215** provides a means to increase stickhandling skills, while the guides **120** (or glasses **290**) light up in sequences to be followed by the user to increase shooting skills without the need for a special puck and with the possibility of using a multitude of pucks **260** to further increase the efficiency of the training session. With specific reference to FIG. **2**, it is also an advantage of the system **110** for the user to look up at the guides **120**, the guides **120** indicating to the user where to shoot the puck **160**. Therefore, the user or player is only looking at a single location, and the guide **120** lights up random target location patterns forcing the player to work on reaction time.

[0038] With reference to FIGS. **4**A, **4**B and **4**C and according to an embodiment of the present disclosure, various targeting portions are shown. A tutor **310** is shown in FIG. **4**A, the tutor **310** being a material that only allows the puck (not shown) to go through apertures **307** having specific shapes and positions on the tutor **310**. Various targets **320** are shown in FIG. **4**B, the targets (which include accelerometer sensors and have the ability to communicate over wired or wireless channels to a microcontroller) **320** hung in a goal **301**. Meanwhile, a wall portion **302** is shown in FIG. **4**C, the wall portion **302** having a plurality of target areas **330** printed on the wall portion **302** or cut out of the wall portion **302** to create apertures.

[0039] With further reference to FIGS. **4**A, **4**B and **4**C and according to one embodiment of the present invention, each one of the apertures **307**, targets **320** and targets areas **330** have an optional indicator light **305**. During shooting prac-

tice, indicator lights **305** are activated, showing the user where to aim at and will be turned off once the task is accomplished, allowing the sequence to continue. Such apertures **307**, targets **320** and targets areas **330** can also be equipped with sensors being able to detect not only if the active target was hit, but also detect incoming puck, an important feature required to track progression of the user's accuracy. A worker skilled in the art would appreciate that the target areas **330** could be apertures, flaps, or simply markings or other targeting means on the wall portion **302**. This is also valid for the tutor **310**. An ideal range of targets quantity is between five and nine.

[0040] With reference to FIG. **5**A and in another embodiment of the present invention, a target **500** for use in the present system is shown. The target **500** is made of semi-conductive material **510** layered with a FR4 PCB **520** for puck impact detection and to communicate over a wired or wireless channel to a microcontroller. A semi conductive material such as Velostat™ or Lingstat™ can be used as the semiconductive material for this target. Other materials such as conductive or semi conductive rubber, conductive or semi conductive foam, conductive or semi conductive felt, conductive or semi conductive silicone, and conductive or semi conductive ink can also be used.

[0041] A conductive material such as copper, silver, gold, or any other conductive material can be used as the positive and negative terminal of the sensor. Conductive fiber imbedded fabrics, conductive foam, or conductive tape can also be used as the positive and negative terminal of the sensor. The semiconductive material has an internal volumetric resistance that changes when pressure is applied to the material. Combining these properties with electrical connections allows to detect a change in voltage throughout the target using a voltage divider or a microcontroller throughout the target. The different layering method of conductive, semi-conductive, and non-conductive materials are used to provide a target with either or both mechanical and electrical pressure sensing abilities allowing to vary the intensity of any routines from the present system.

[0042] With further reference to FIG. **5**A and according to one embodiment of the present invention, target **500** is made of a semi-conductive carbon-infused PE **510** layered in front of a FR4 PCB **520** for puck impact detection.

[0043] With reference to FIGS. **5**B and **5**C and according to one embodiment of the present invention, there are 2 methods available for the target **500** to detect impacts. FIG. **5**B shows the two different terminals, **540** and **550**, in consecutive rows and connected using a single layer PCB. A crisscross pattern, such as depicted in FIG. **5**C, is preferred. In this configuration, **560** and **570** terminals are in a checkered configuration via a routing of the connections on a dual-layer PCB (not shown). A PCB with a conductive pad can also be used as the positive and negative terminal of the sensor.

[0044] With reference to FIGS. **5**D to **5**H and according to other embodiments of the present invention, various targets are shown for use in the present system. These various configurations allow the present system to provide different results either in measurement or in display. With reference to FIG. **5**D and according to one embodiment of the present invention, target **500** is shown having a protective front layer **600** and an LED **610**. PCB **620** is present in the central portion of the target **500** allowing for various functions of the target as described in the present disclosure. A semi-conductive layer **630** is positioned between protective front layer **610** and PCB **620**. An enclosure **640** provides further rigidity to target **500**.

[0045] With reference to FIG. **5**E and according to another embodiment of the present invention, a target **500** is shown having a number of layers providing for different functions and protection from the environment and puck impact for example. Target **500** has LED **610** within a nylon frame **650**. Non-conductive PE polyethylene layers **660** and **662** are present to seal against weather effects such as rain or snow. Target **500** has conductive copper strips **670** and **672** which act as ground terminals. Further layers of carbon embedded material **680**,**682** and carbon embedded polyethylene (PE) **690**, **692** are also present allowing specific functions to the target. A final middle layer **700** is present as a non-conductive layer to separate the carbon imbedded PE layers **690** and **692**.

[0046] With reference to FIGS. **5**F and **5**G and according to one embodiment of the present invention, a target **500** is shown having a LED **610** and a semi-conductive layer **630** wherein the LED **610** is installed on PCB **620**. A protective membrane **600** can also be present.

[0047] With reference to FIG. **6** and according to one embodiment of the present disclosure, an interactive hockey training software application **800** is shown. The interactive hockey training application **800** consist of connecting N-number of training systems **810** from the present disclosure to a game control device **820**. Game Control Device **820** is responsible for connecting 'n' number of training systems **810** via bluetooth/wifi connections. Once the connection is established the game control device **820** lets players send commands to start training, end training and other training configurations and modes to the connected training systems **810**.

[0048] Each connected training system **810** sends training data to game control device **820** in real time. The data is saved locally using a local database for further processing. After completing a training session the data is further cleaned and sent to a cloud system **830** to be accessed on a game analytics device.

[0049] The cloud system **830** is responsible for maintaining all historical data for players' training, analyze their progress using AI and machine learning methods. A recommendation engine is used to propose new training patterns and schedules to the players which can be displayed on a Game analysis device **840**. Game Analysis Device **840** is a display device/application that collects historic training and analyses data from the cloud and presents it to a user.

[0050] The Game Control Device **820** and the Game Analysis Device **840** allow players to connect with other players, and the ability to train together physically and remotely. The system **800** lets users to challenge other user or allows them to participate in a training challenge.

[0051] The Game Control Device **820** and the Game Analysis Device **840** also allows users to share their training stats, challenge performance, training pattern and training progress with other players.

[0052] The game control device **820** and game analysis device **840** can be different devices or can be on a single device allowing for both functions of the control and analysis devices. A worker skilled in the relevant art would be familiar with the implementation of available software architecture to combine both features into a single device.

[0053] A worker skilled in the art would appreciate that although the present embodiments are directed to hockey training specifically, the systems **10**, **110**, **210** could be used for other sports, including but not limited to soccer, baseball, football, racket ball, etc or simply general conditioning and fitness. A worker skilled in the art would also appreciate that each of the systems **10**, **110**, **210** will analyze the training and conditioning to generate data that is used to improve the ability of the operator of the systems **10**, **110**, **210**.

1. A system for conditioning and training comprising:

a floor portion further comprising a plurality of radio-frequency identification (RFID) tags; and,

at least one guide within a line of sight from the floor portion,

wherein the system displays instructions on the at least one guide and determines a correct position of an object on the floor portion,

and wherein data is generated to improve conditioning and training an operator.

2. The system of claim **1** wherein the at least one guide is a display unit.

3. The system of claim **2** wherein the object is a puck having at least one printed circuit board.

4. The system of claim **3** wherein the puck communicates with the display unit.

5. The system of claim **1** further comprising the display of past results and results from other systems for conditioning and training.

6. A system for conditioning and training comprising:

at least one guide within a line of sight from a surface area; and,

at least one apparatus,

wherein the system displays instructions on the at least one guide and the at least one apparatus determines a correct position of at least one object on the surface area,

and wherein data is generated to improve conditioning and training an operator.

7. The system of claim **6** wherein the object is a puck.

8. The system of claim **7** further comprising targets for use with the puck.

9. The system of claim **8** further comprising a printed circuit board in the targets for communicating with the at least one guide.

10. The system of claim **7** further comprising a wall portion with target areas for use with the puck.

11. The system of claim **9** wherein the at least one guide is a display unit.

12. The system of claim **11** further comprising a game control device and game analysis device.

13. The system of claim **12** wherein the game control device connects an n-number of systems for conditioning and training to the game analysis device.

14. The system of claim **6** wherein the apparatus is a camera.

15. The system of claim **6** wherein the apparatus is an AR unit in the form of glasses.

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