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(54) **WIRELESS SENSOR SCORING WITH AUTOMATIC SENSOR SYNCHRONIZATION**

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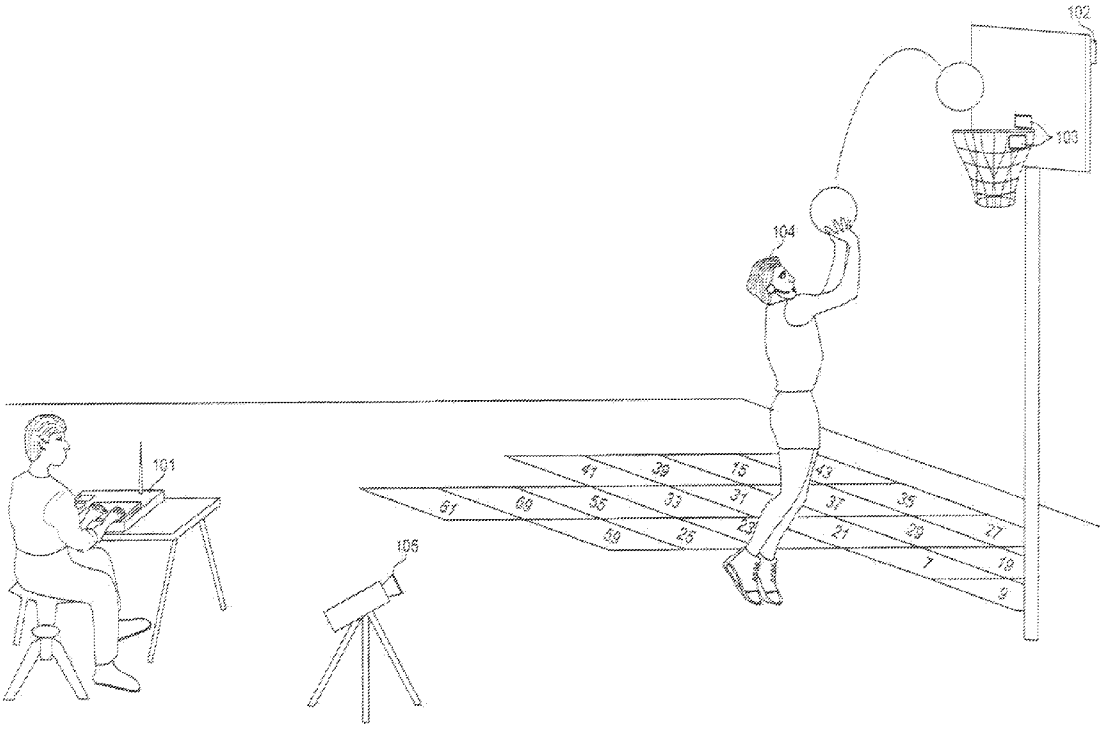
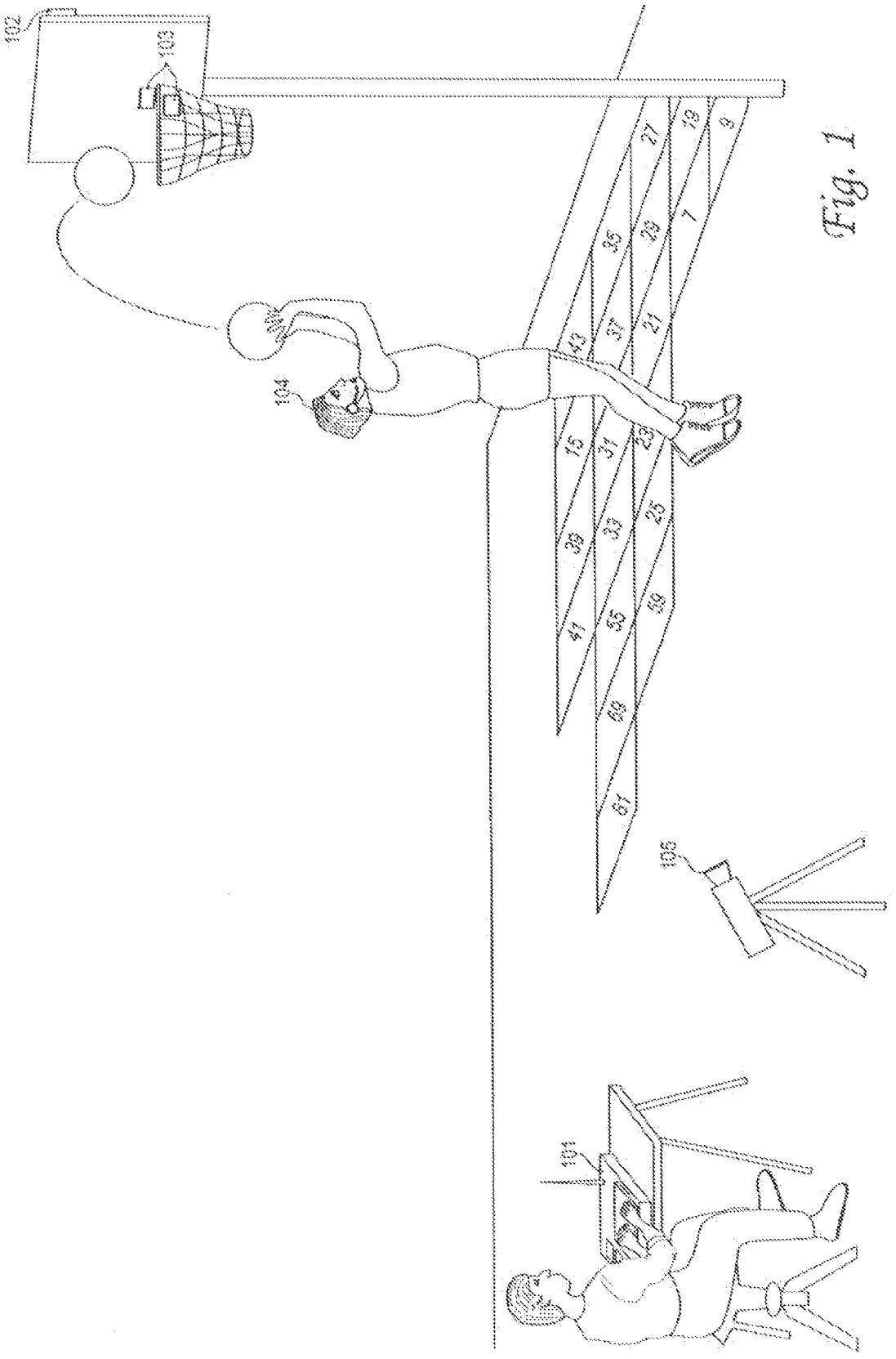
(57) **ABSTRACT**

Embodiments provide mechanisms and methods for measuring shooting performance in multiplayer environments. These mechanisms and methods include automatic synchronization that enables sensors associated with multiple players to interact with one or more control consoles in a common playing area free of interference. The ability to associate sensors to interact with one or more control consoles in a common playing area free of interference make it possible for coaches and players to measure levels of play, build teamwork among multiple players, improve and maintain skills, select players to meet game situations and team requirements, make decisions on player roles, and use playing environment space more efficiently.

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103
104
106
101
9
19
27
1
29
35
21
37
43
15
31
23
39
33
25
41
55
69
69
67

Fig. 1

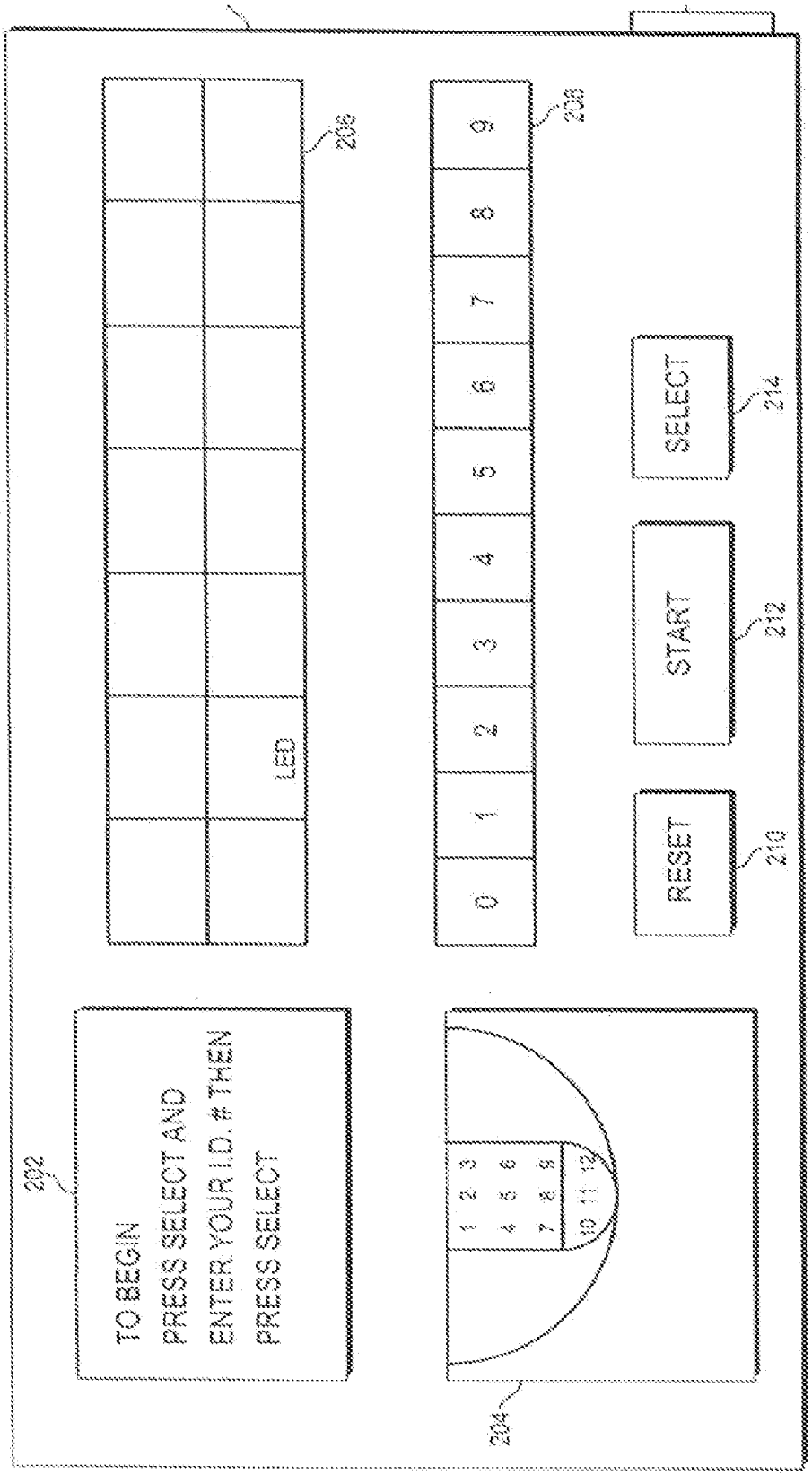

206
LED
208
0
1
2
3
4
5
6
7
8
9
RESET
210
START
212
SELECT
214
202
TO BEGIN
PRESS SELECT AND
ENTER YOUR I.D. # THEN
PRESS SELECT
204

Fig. 2A

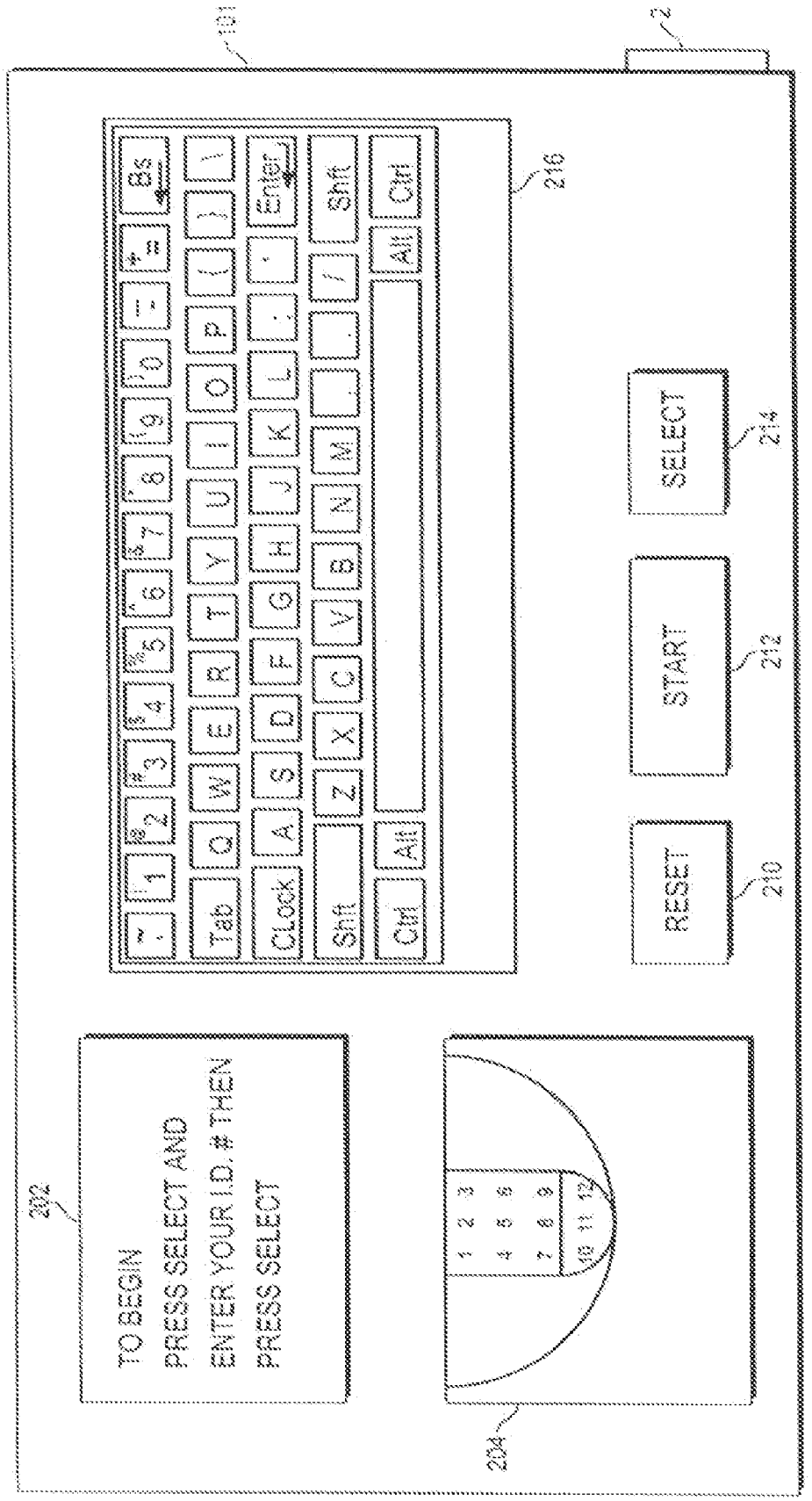

101
2
216
RESET
210
START
212
SELECT
214
TO BEGIN
PRESS SELECT AND
ENTER YOUR I.D. # THEN
PRESS SELECT
202
204
Tab
Clock
Shft
Ctrl
Alt
Enter
Bs
Shft
Ctrl
Alt

Fig. 2B

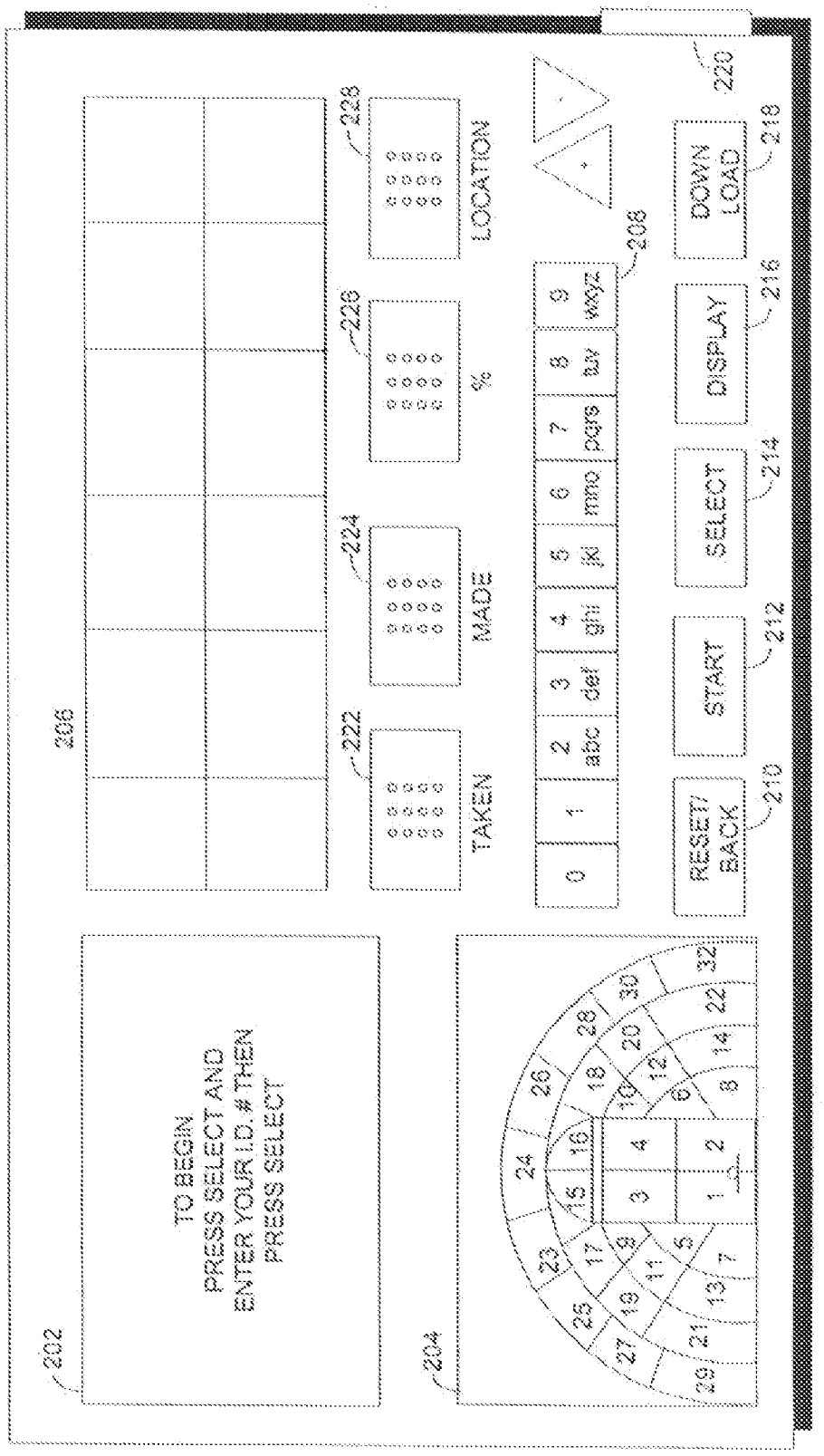

101
206
228
LOCATION
226
%
224
MADE
222
TAKEN
208
0
1
2 abc
3 def
4 ghi
5 jkl
6 mno
7 pqrs
8 tuv
9 wxyz
RESET/ BACK
210
START
212
SELECT
214
DISPLAY
216
DOWN LOAD
218
220
202
TO BEGIN
PRESS SELECT AND
ENTER YOUR I.D. # THEN
PRESS SELECT
204

Fig. 2C

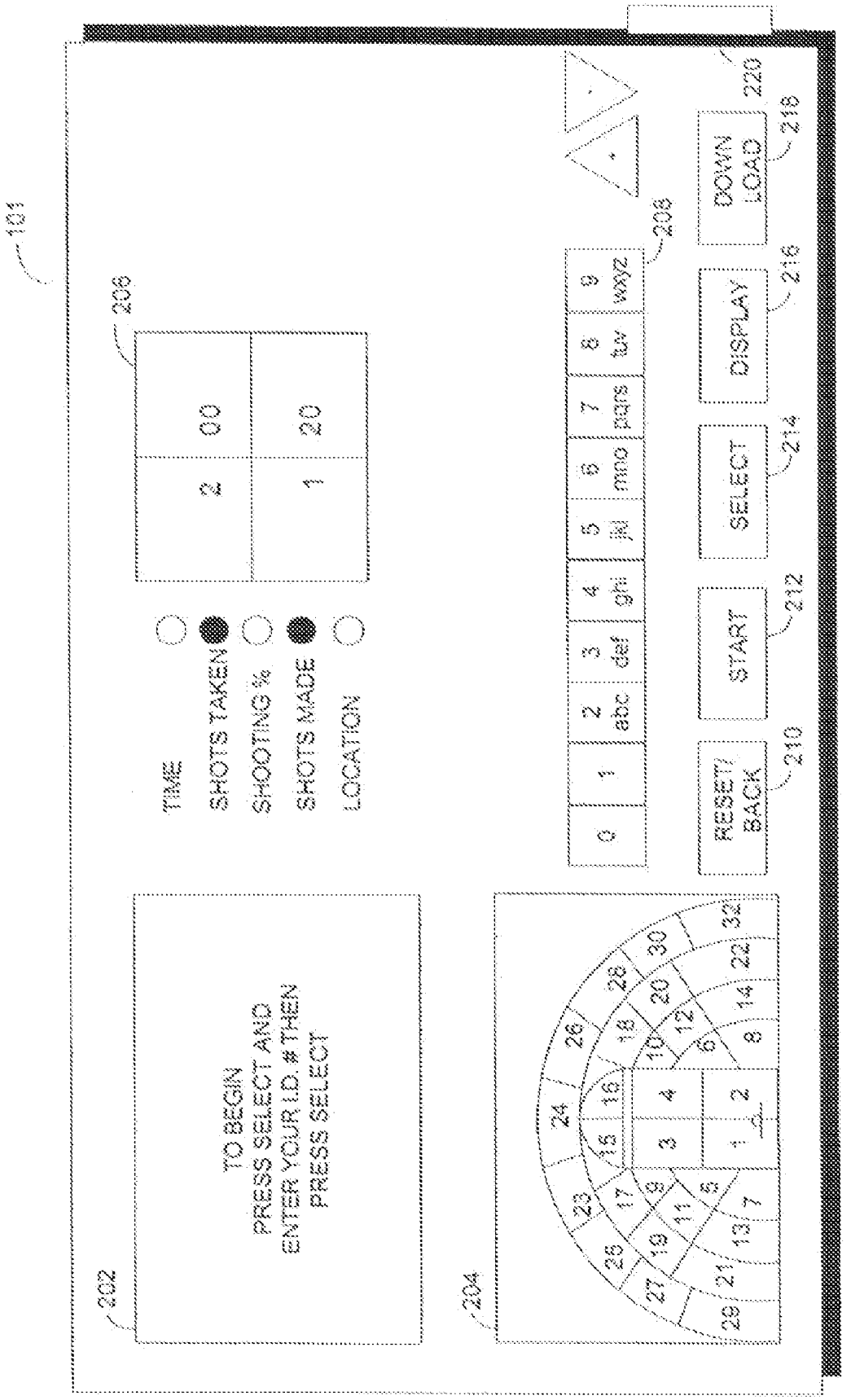

101
206
TIME
2 00
SHOTS TAKEN
SHOOTING %
SHOTS MADE
1 20
LOCATION
208
0
1
2 abc
3 def
4 ghi
5 jkl
6 mno
7 pqrs
8 tuv
9 wxyz
RESET/ BACK
210
START
212
SELECT
214
DISPLAY
216
DOWN LOAD
218
220
202
TO BEGIN
PRESS SELECT AND
ENTER YOUR I.D. # THEN
PRESS SELECT
204

Fig. 2D

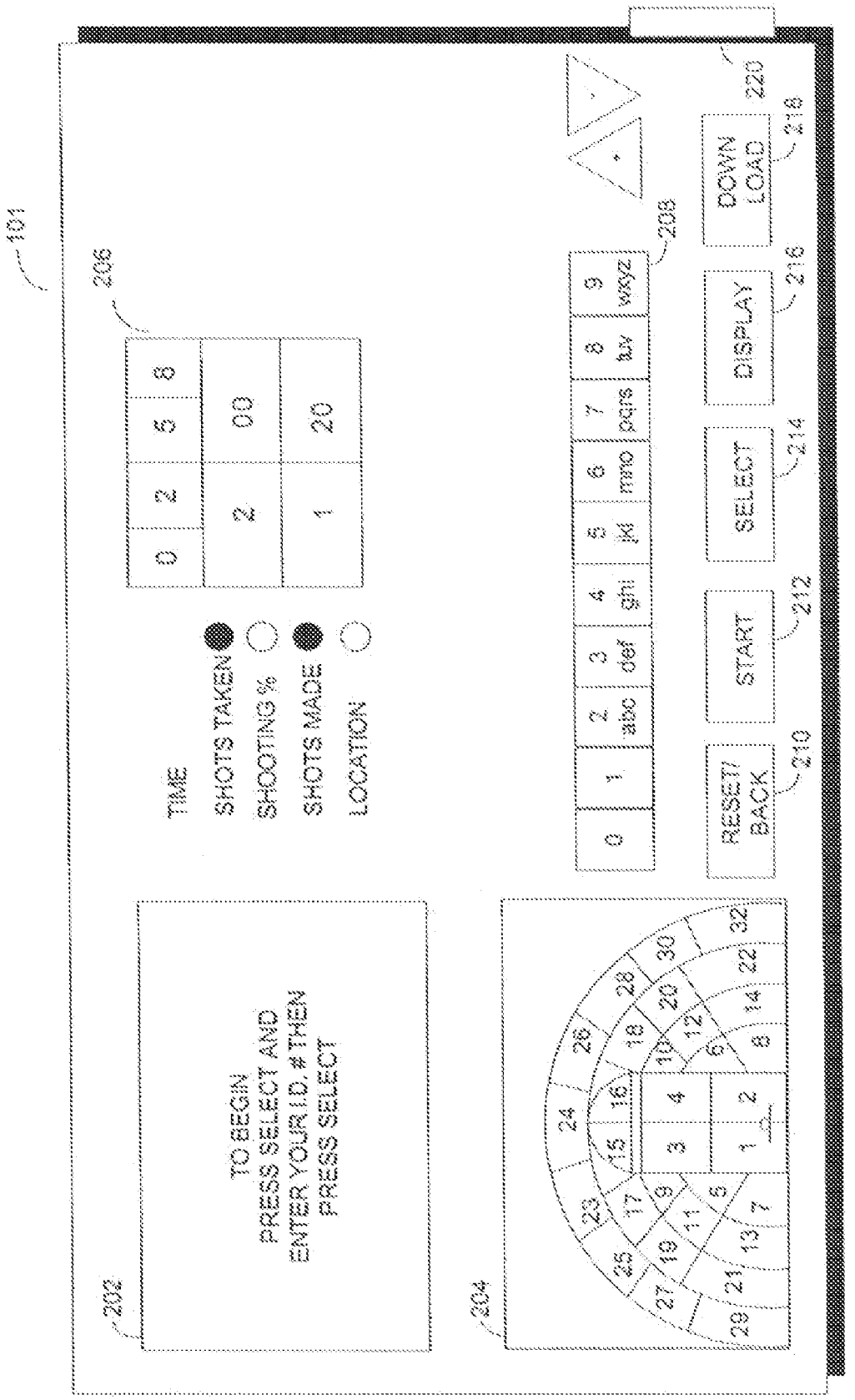

101
206
TIME
SHOTS TAKEN
SHOOTING %
SHOTS MADE
LOCATION
0 2 5 8
2 00
1 20
208
0 1 2 abc 3 def 4 ghi 5 jkl 6 mno 7 pqrs 8 tuv 9 wxyz
RESET/ BACK
210
START
212
SELECT
214
DISPLAY
216
DOWN LOAD
218
220
202
TO BEGIN
PRESS SELECT AND
ENTER YOUR I.D. # THEN
PRESS SELECT
204
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32

Fig. 2E

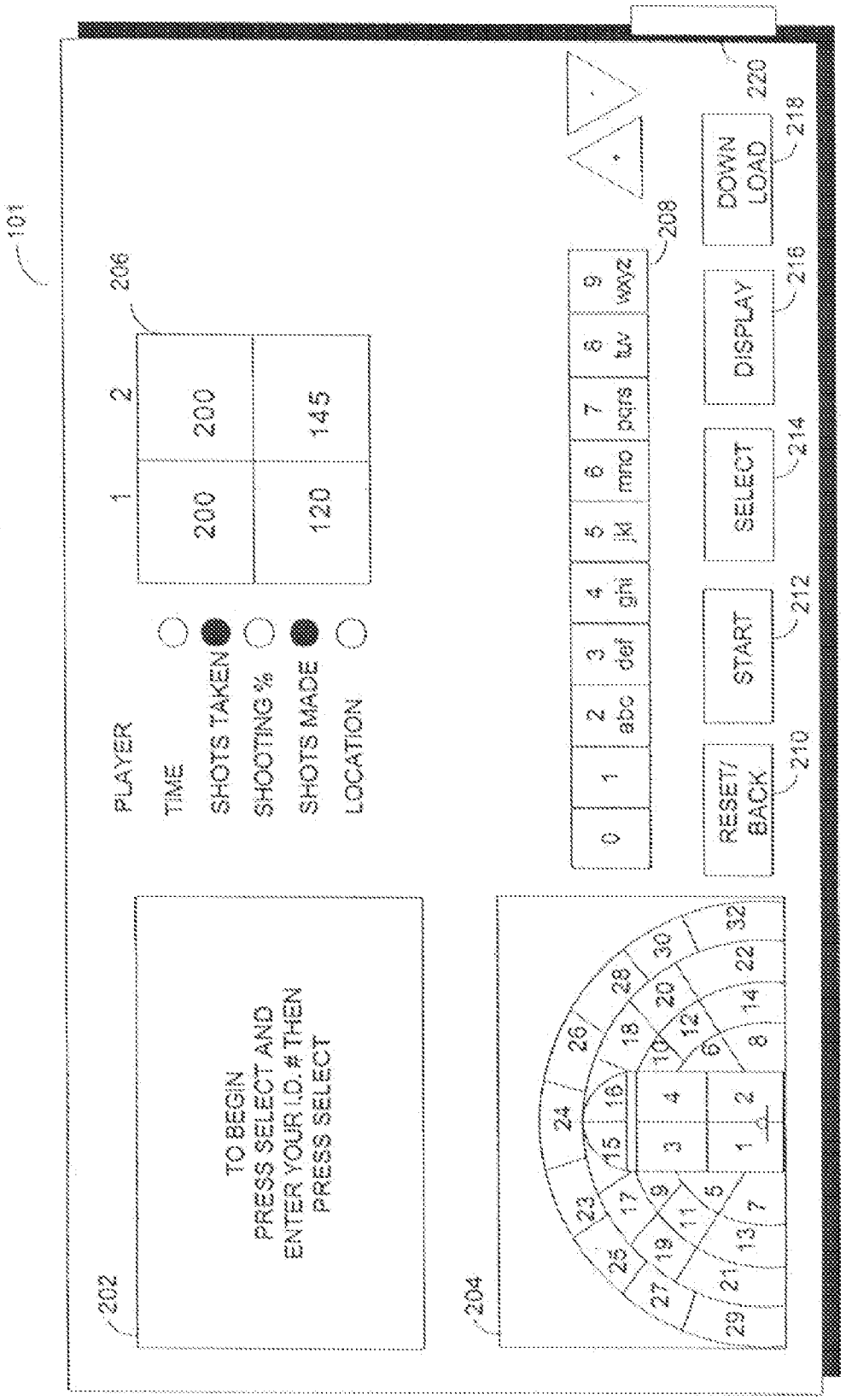

101
206
1
2
PLAYER
TIME
SHOTS TAKEN
SHOOTING %
SHOTS MADE
LOCATION
200
200
120
145
208
0
1
2 abc
3 def
4 ghi
5 jkl
6 mno
7 pqrs
8 tuv
9 wxyz
RESET/ BACK
210
START
212
SELECT
214
DISPLAY
216
DOWN LOAD
218
220
202
TO BEGIN
PRESS SELECT AND
ENTER YOUR I.D. # THEN
PRESS SELECT
204

Fig. 2F

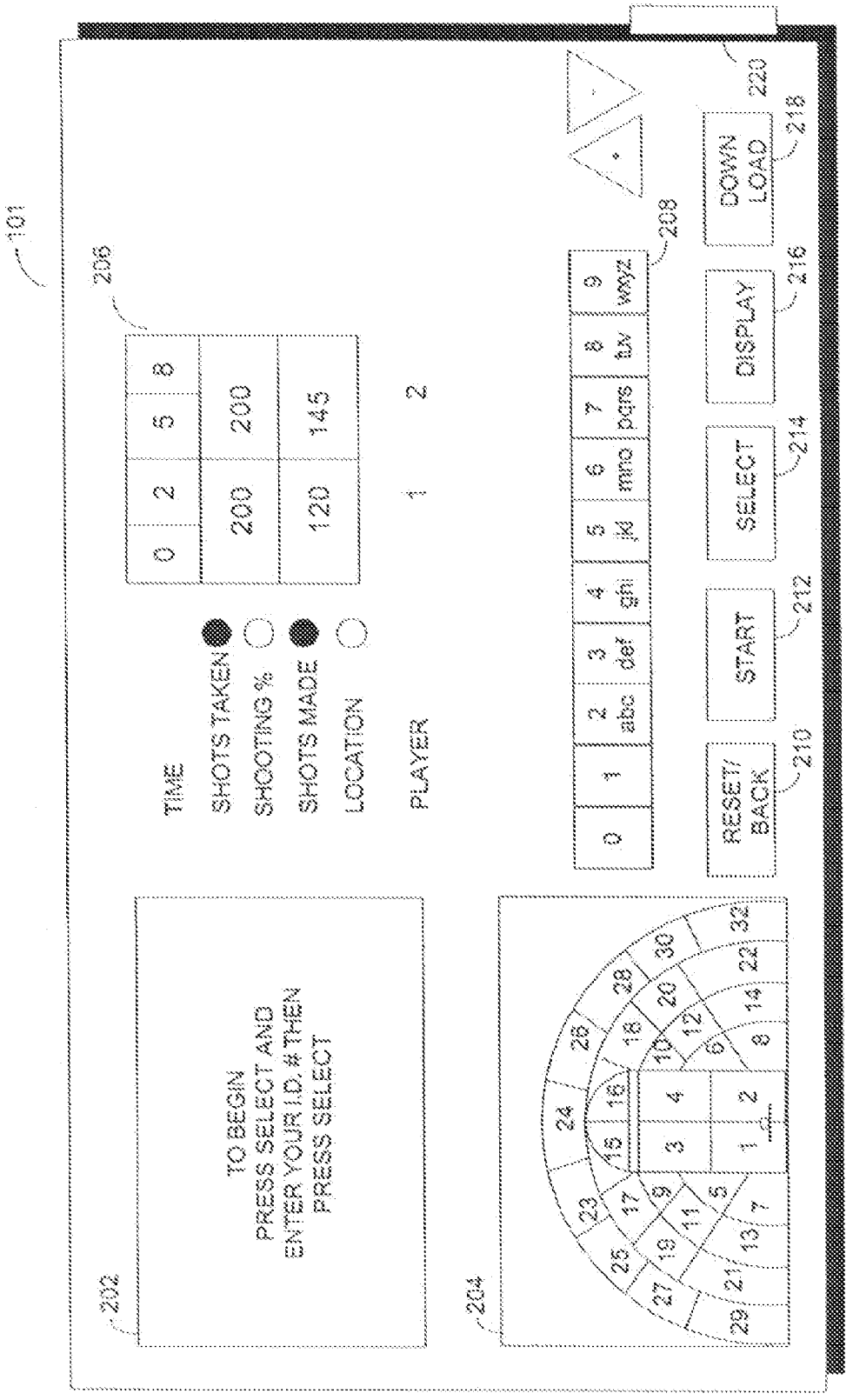

101
206
TIME
SHOTS TAKEN
SHOOTING %
SHOTS MADE
LOCATION
PLAYER
0 2 5 8
200 200
120 145
1 2
202
TO BEGIN
PRESS SELECT AND
ENTER YOUR I.D. # THEN
PRESS SELECT
204
208
0 1 2 abc 3 def 4 ghi 5 jkl 6 mno 7 pqrs 8 tuv 9 wxyz
RESET/ BACK
210
START
212
SELECT
214
DISPLAY
216
DOWN LOAD
218
220

Fig. 2G

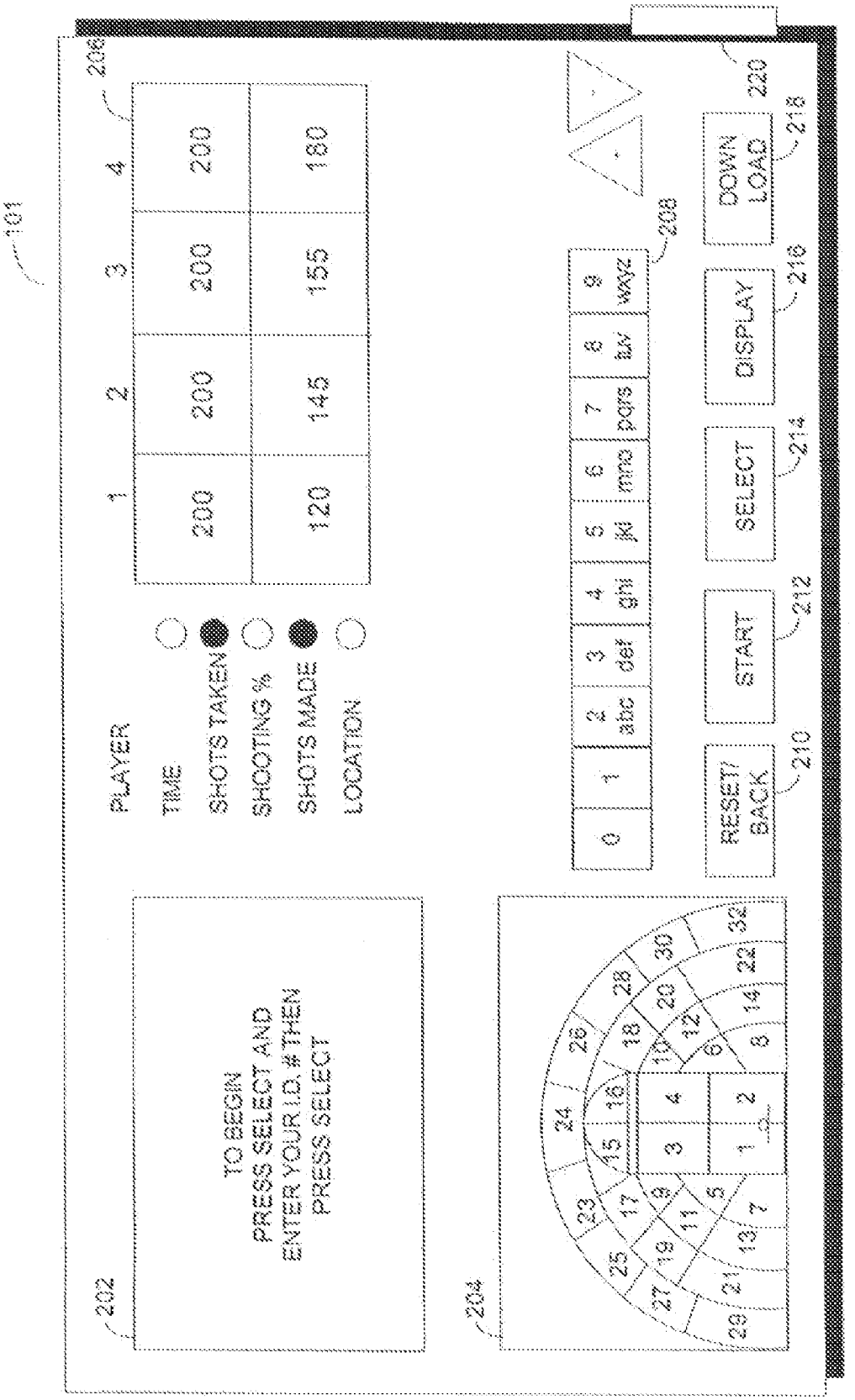

101
206
PLAYER
TIME
SHOTS TAKEN
SHOOTING %
SHOTS MADE
LOCATION
1
2
3
4
200
200
200
200
200
200
120
145
155
180
202
TO BEGIN
PRESS SELECT AND
ENTER YOUR I.D. # THEN
PRESS SELECT
204
208
0
1
2 abc
3 def
4 ghi
5 jkl
6 mno
7 pqrs
8 tuv
9 wxyz
RESET/ BACK
210
START
212
SELECT
214
DISPLAY
216
DOWN LOAD
218
220

Fig. 2H

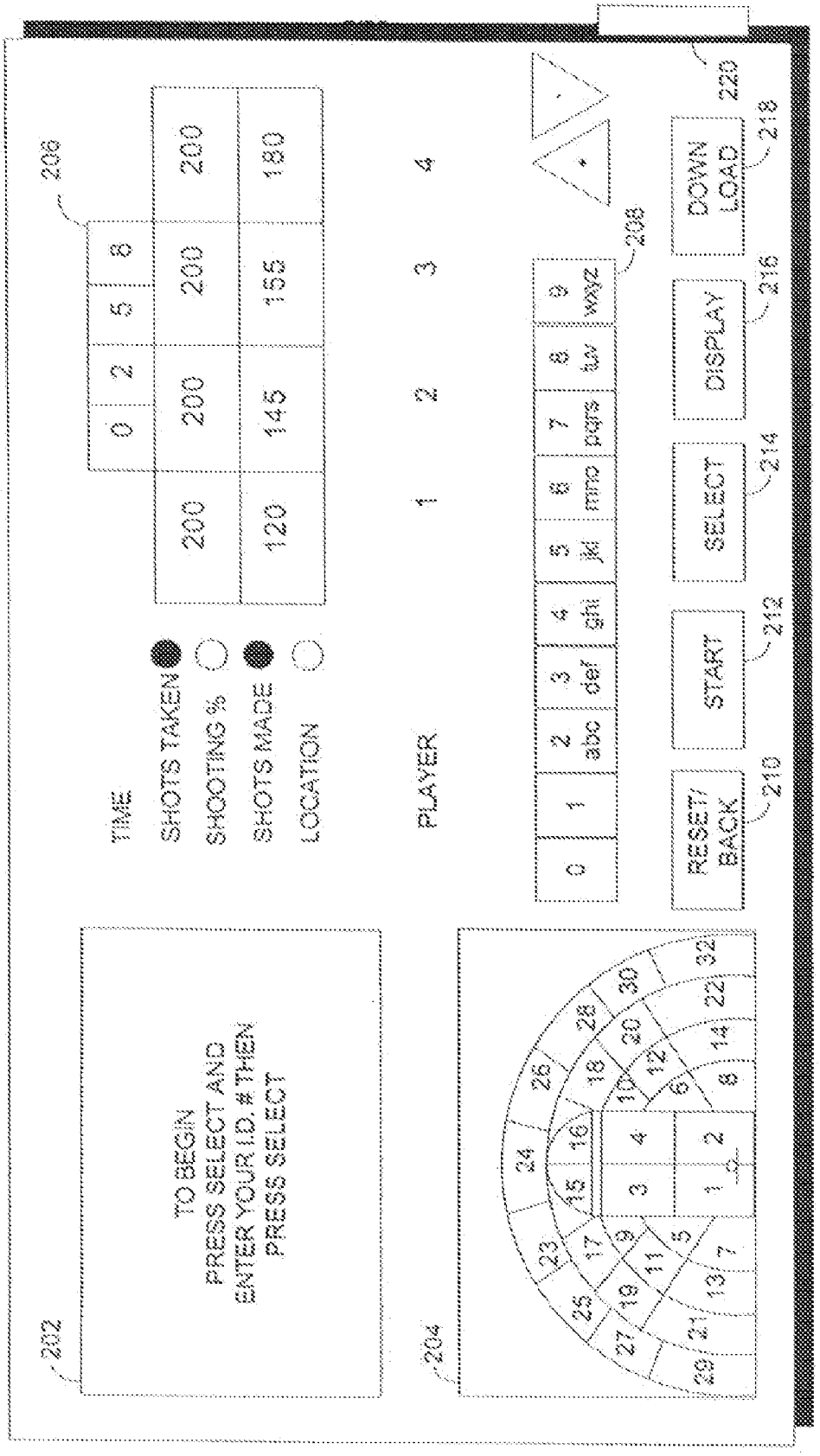

101
206
TIME
0
2
5
8
SHOTS TAKEN
200
200
200
200
SHOOTING %
SHOTS MADE
120
145
155
180
LOCATION
PLAYER
1
2
3
4
202
TO BEGIN
PRESS SELECT AND
ENTER YOUR I.D. # THEN
PRESS SELECT
204
208
0
1
2 abc
3 def
4 ghi
5 jkl
6 mno
7 pqrs
8 tuv
9 wxyz
RESET/ BACK
210
START
212
SELECT
214
DISPLAY
216
DOWN LOAD
218
220

Fig. 2I

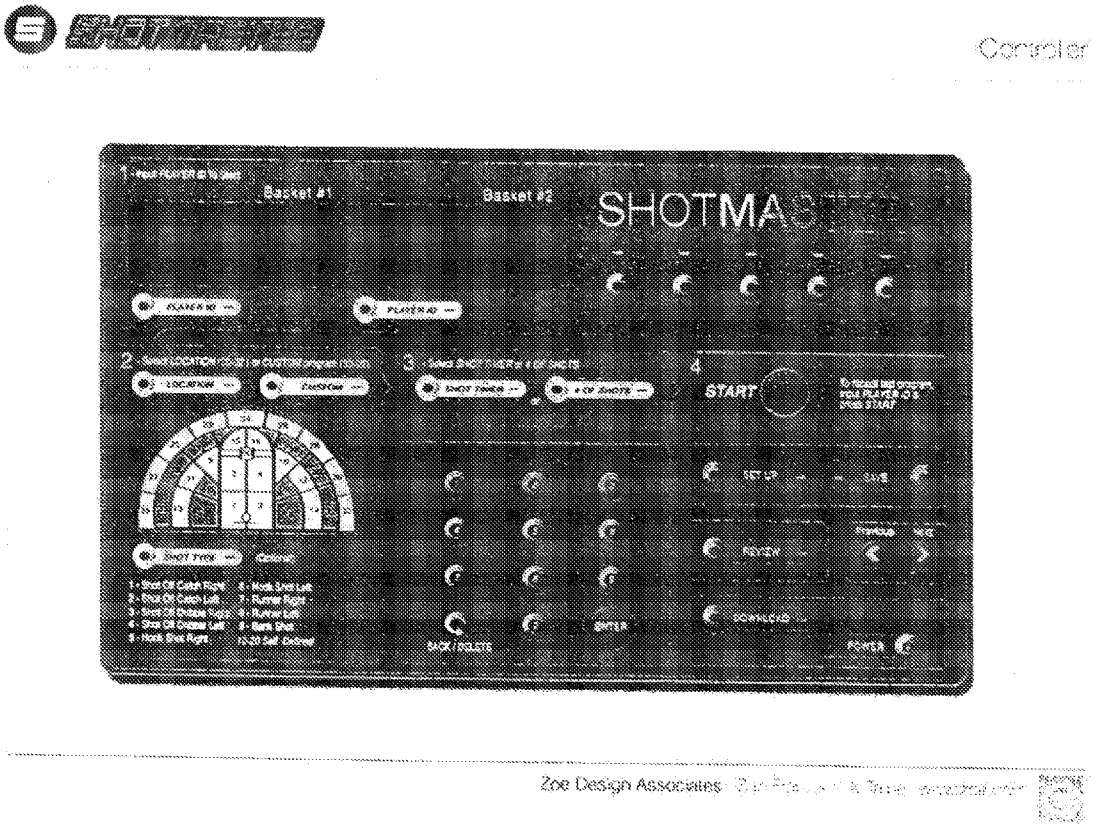
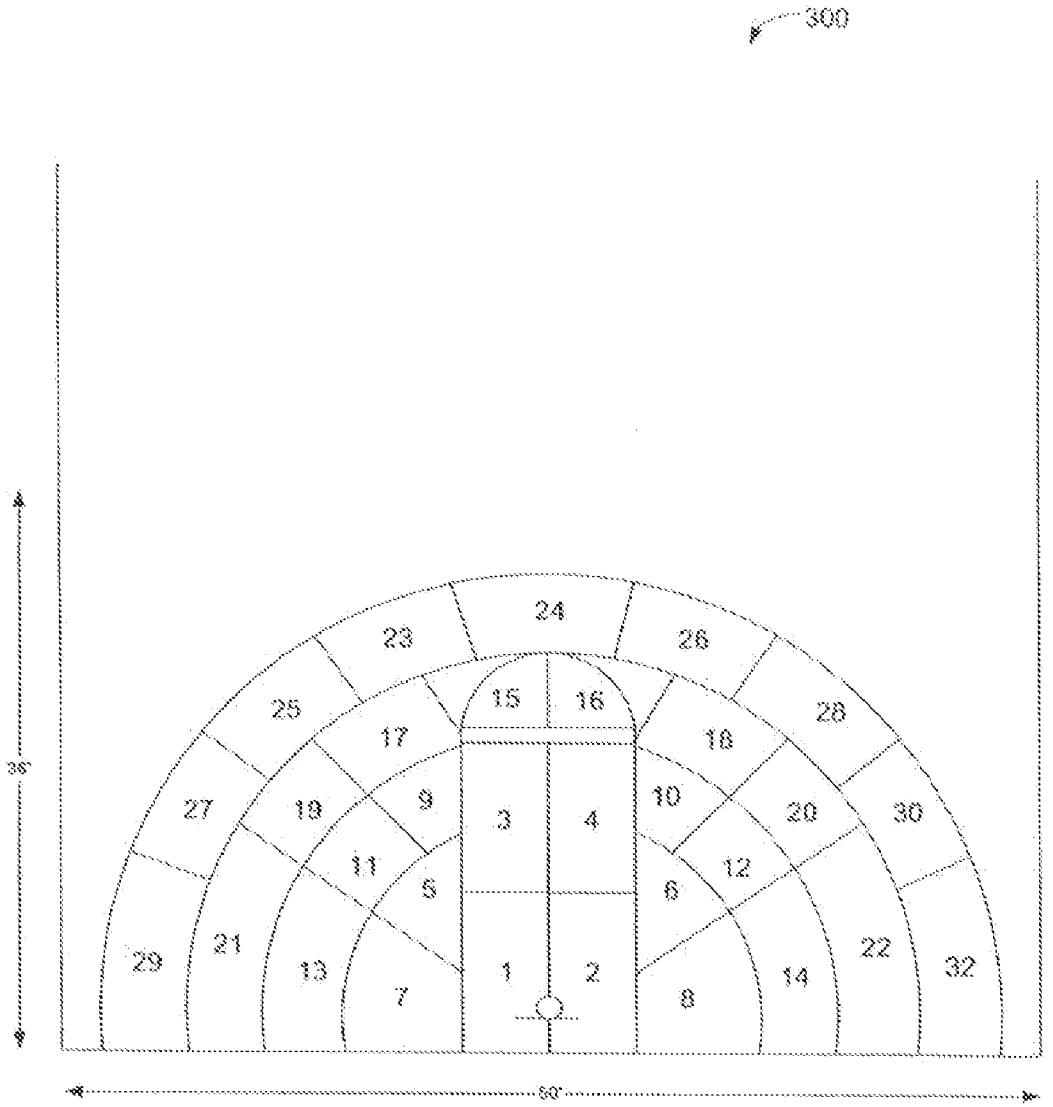


Fig. 21


300
36"
60"
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
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26
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29
30
32

Fig. 3A

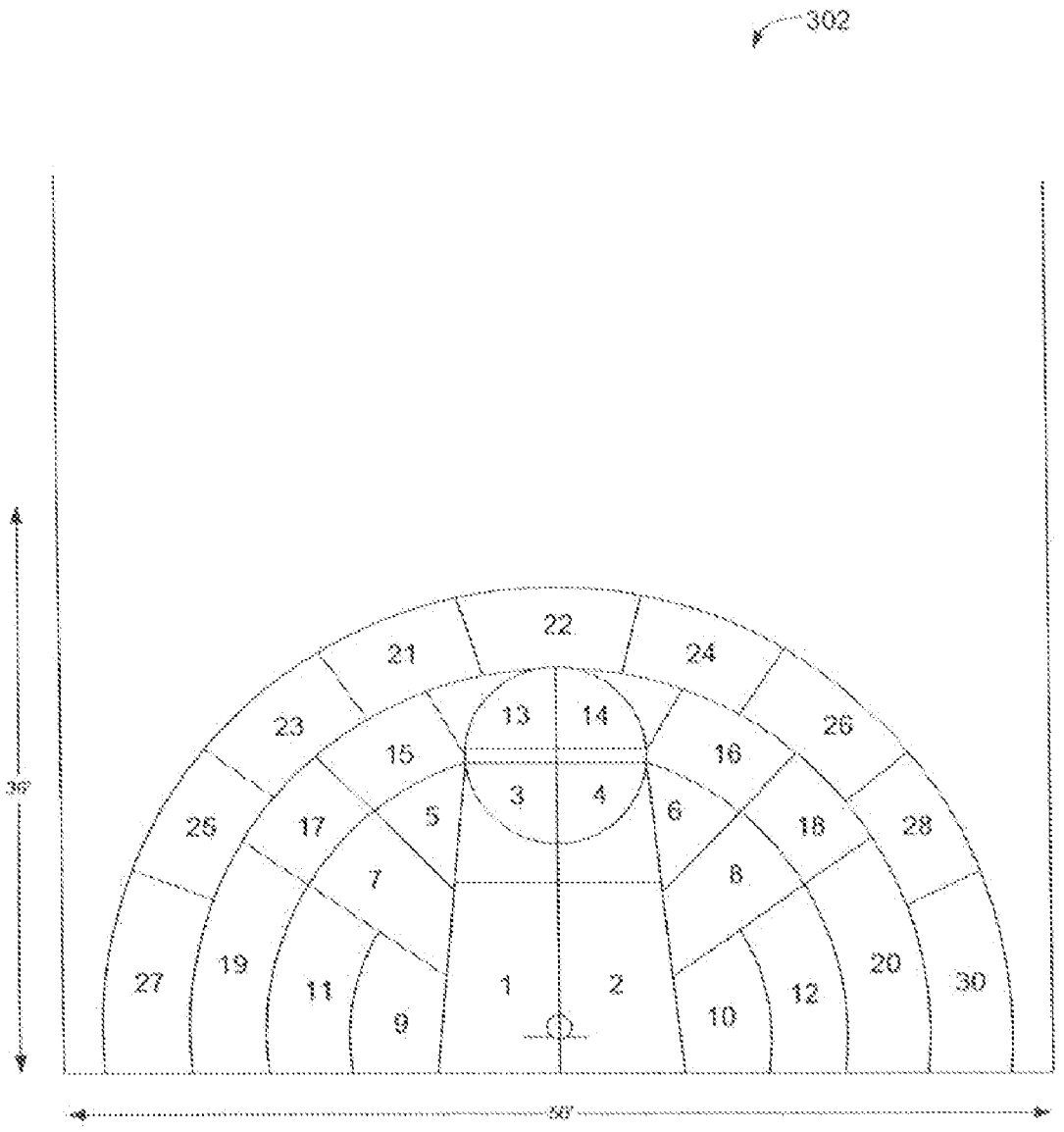
302
36"
60"
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
26
27
28
30

Fig. 3B

- ENTER NUMBER OF SHOOTERS
- ENTER SHOOTER ID# OR NAME
- ENTER # OF MINUTES OR NUMBER OF SHOTS TO TAKE
- ENTER SHOT LOCATION (CELL, 3FT.CYCLE, OR PROGRAM)
- ENTER SHOT TYPE
- PRESS START

Fig. 9A

- ENTER NUMBER OF SENSOR PAIRS
- DEPRESS SYNCH BUTTON ON SENSOR # 1
- DEPRESS SYNCH BUTTON ON SENSOR # 2

  ○

  ○

  ○

- DEPRESS SYNCH BUTTON ON SENSOR # n
- SYNCHRONIZATION COMPLETE

Fig. 4B

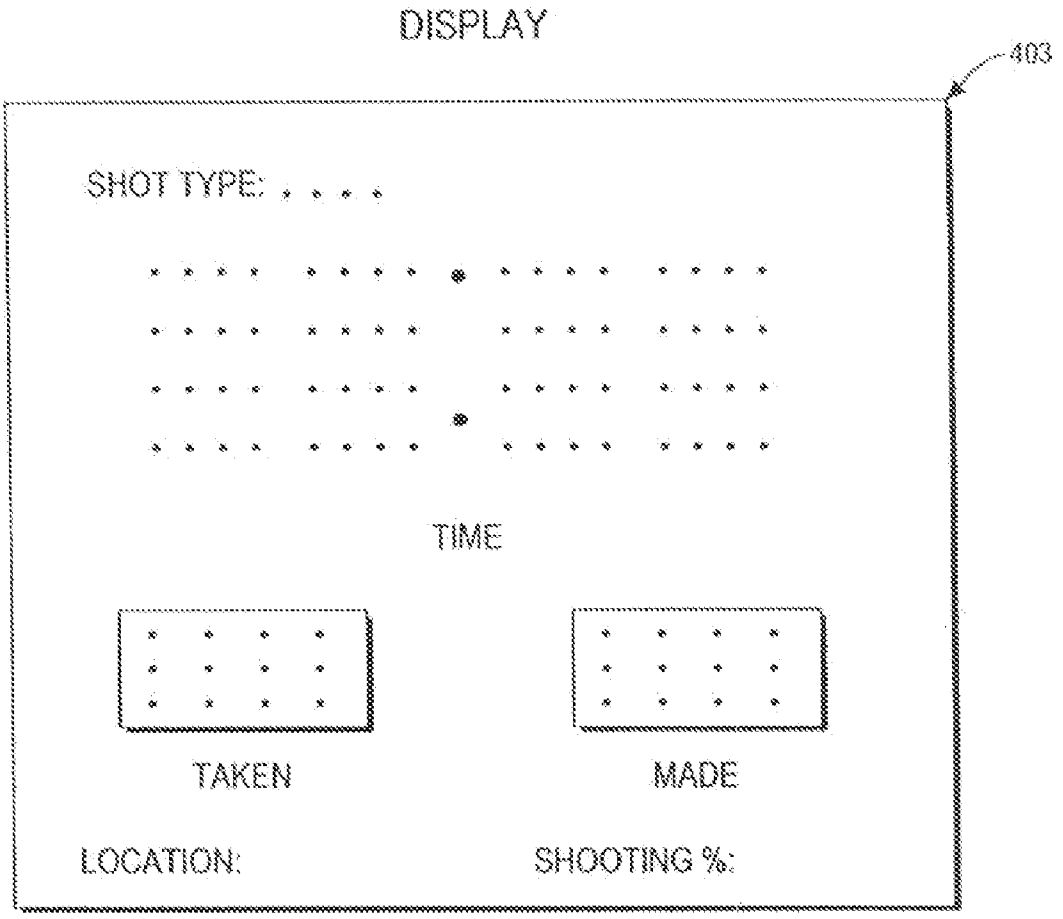

Fig. 4C

SHOT TYPES

1. JUMP SHOT OFF CATCH RIGHT
2. JUMP SHOT OFF CATCH LEFT
3. SHOT OFF DRIBBLE RIGHT
4. SHOT OFF DRIBBLE LEFT
5. HOOK SHOT RIGHT
6. HOOK SHOT LEFT
7. RUNNER RIGHT
8. RUNNER LEFT
9. BANK SHOT

10 - 50. SELF DEFINED

Fig. 5

INPUT DATA AND MEASUREMENTS

TYPICAL HISTORICAL DATA

SHOOTER: I.D. PERFORMANCE DATA
SHOOTING TIME: MINUTES AND SECONDS
SHOT LOCATION: AS SPECIFIED
DATE AND TIME OF WORKOUT - CYCLE NUMBER
OPTION: ENTER # OF SHOTS TO BE TAKEN

TYPICAL MEASURED DATA:

- LOCATION
- NO. SHOTS TAKEN
- NO. SHOTS MADE
- ELAPSED TIME
- PERSONAL RECORD
- % MADE

TYPICAL RESULTS (PER CYCLE, CUMMULATIVE, BY DATES):

- SHOOTING % BY LOCATION
- HISTORICAL SHOOTING STATISTICS
- SHOTS TAKEN
- SHOTS MADE

Fig. 6

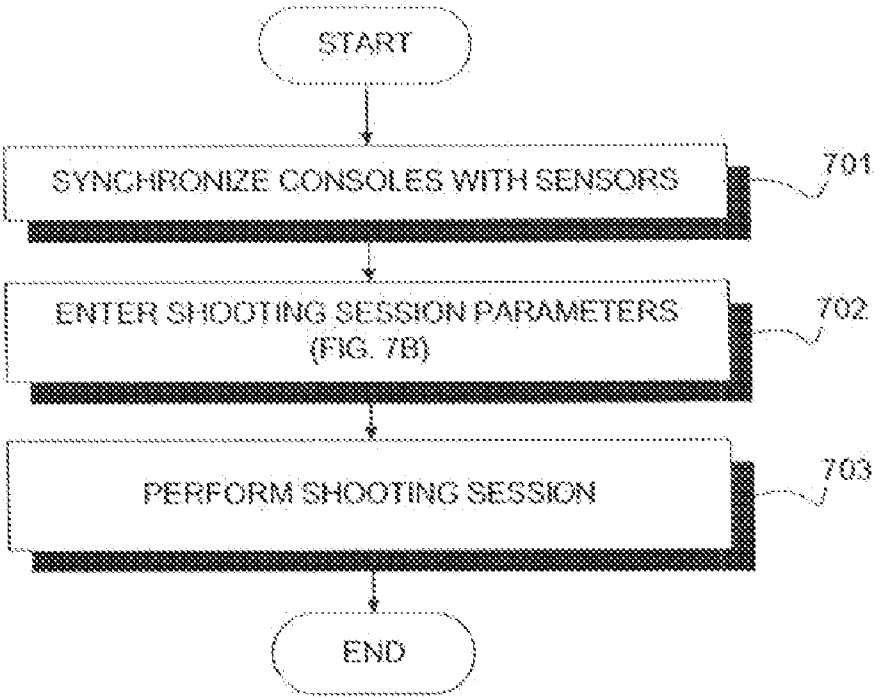
START
SYNCHRONIZE CONSOLES WITH SENSORS
701
ENTER SHOOTING SESSION PARAMETERS (FIG. 7B)
702
PERFORM SHOOTING SESSION
703
END

Fig. 7A

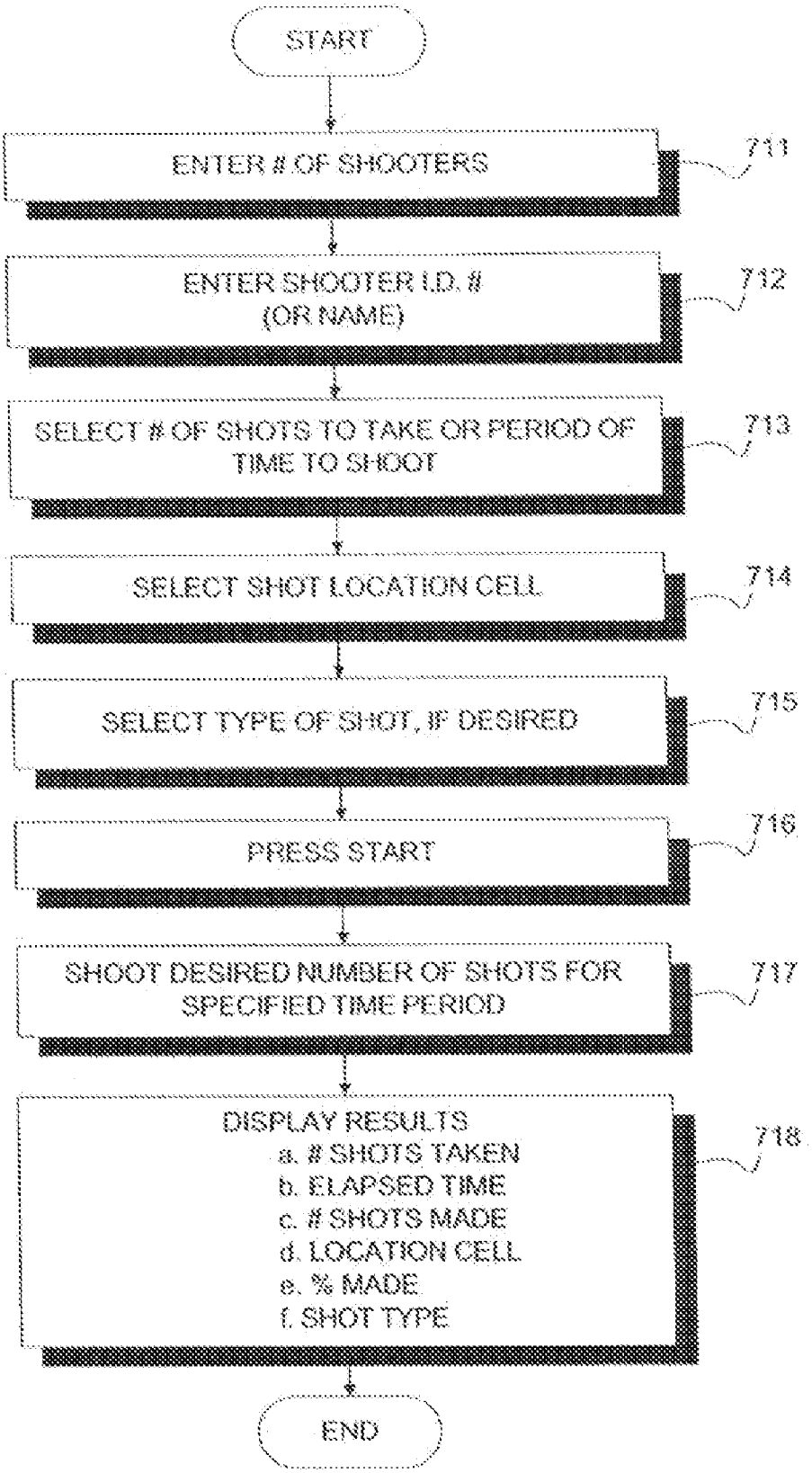
START
ENTER # OF SHOOTERS
711
ENTER SHOOTER I.D. # (OR NAME)
712
SELECT # OF SHOTS TO TAKE OR PERIOD OF TIME TO SHOOT
713
SELECT SHOT LOCATION CELL
714
SELECT TYPE OF SHOT, IF DESIRED
715
PRESS START
716
SHOOT DESIRED NUMBER OF SHOTS FOR SPECIFIED TIME PERIOD
717
DISPLAY RESULTS
a. # SHOTS TAKEN
b. ELAPSED TIME
c. # SHOTS MADE
d. LOCATION CELL
e. % MADE
f. SHOT TYPE
718
END

Fig. 7B

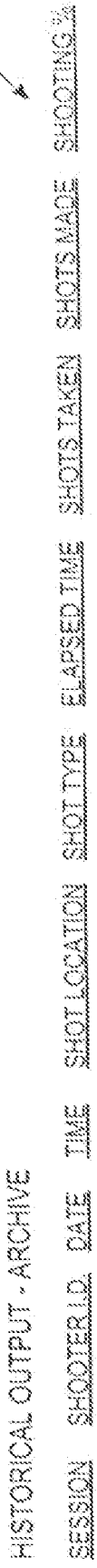
600
HISTORICAL OUTPUT - ARCHIVE
SESSION
SHOOTER I.D.
DATE
TIME
SHOT LOCATION
SHOT TYPE
ELAPSED TIME
SHOTS TAKEN
SHOTS MADE
SHOOTING %
1.
2.
3.
4.
5.
6.
7.
8.
9.
10.

Fig. 8A

Report Output

Report 1 Weekly Summary by Day

Week 1	Shooter	Shot Type	Shot Location	Shots Taken	Shots Made	Shooting %	Shots Made Per Minute

Fig. 8B

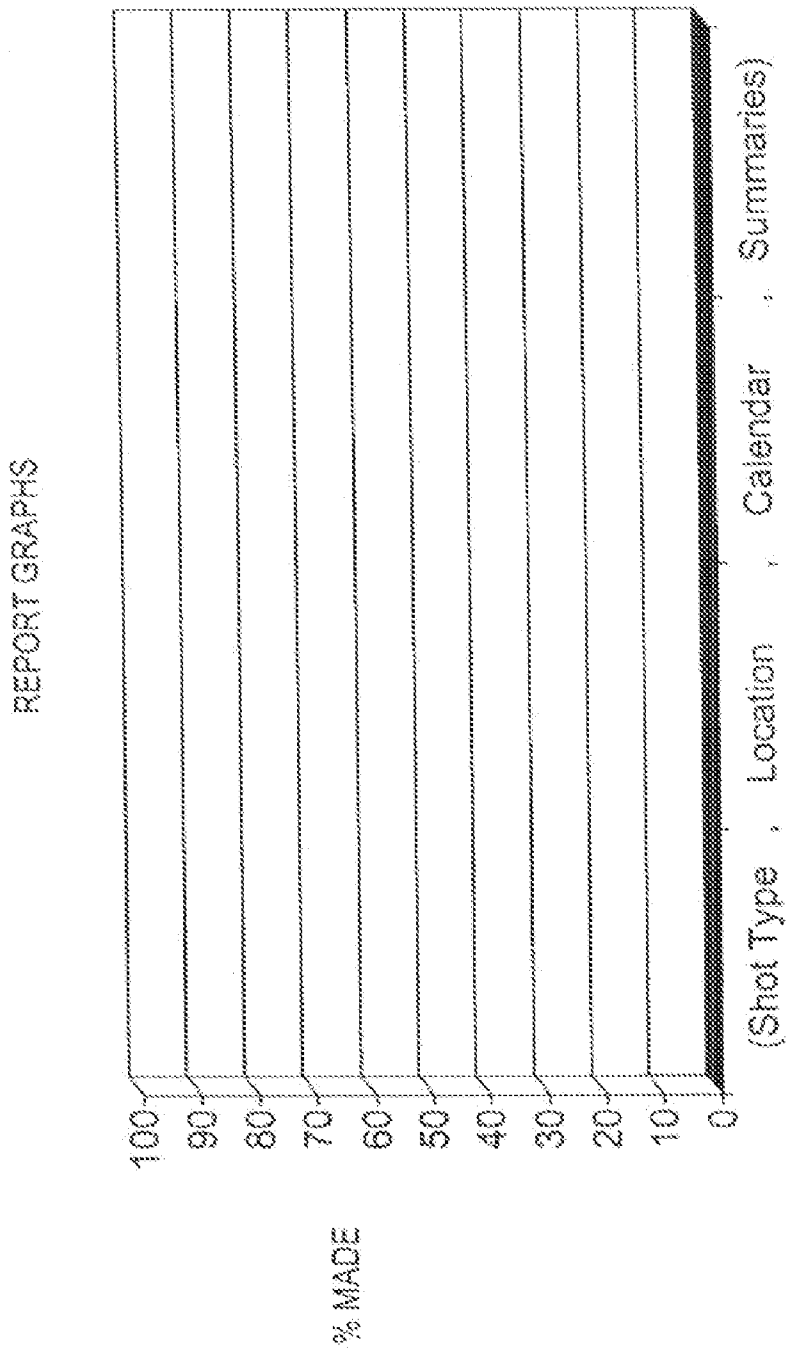
REPORT GRAPHS
% MADE
100
90
80
70
60
50
40
30
20
10
0
(Shot Type , Location , Calendar , Summaries)

Fig. 8C

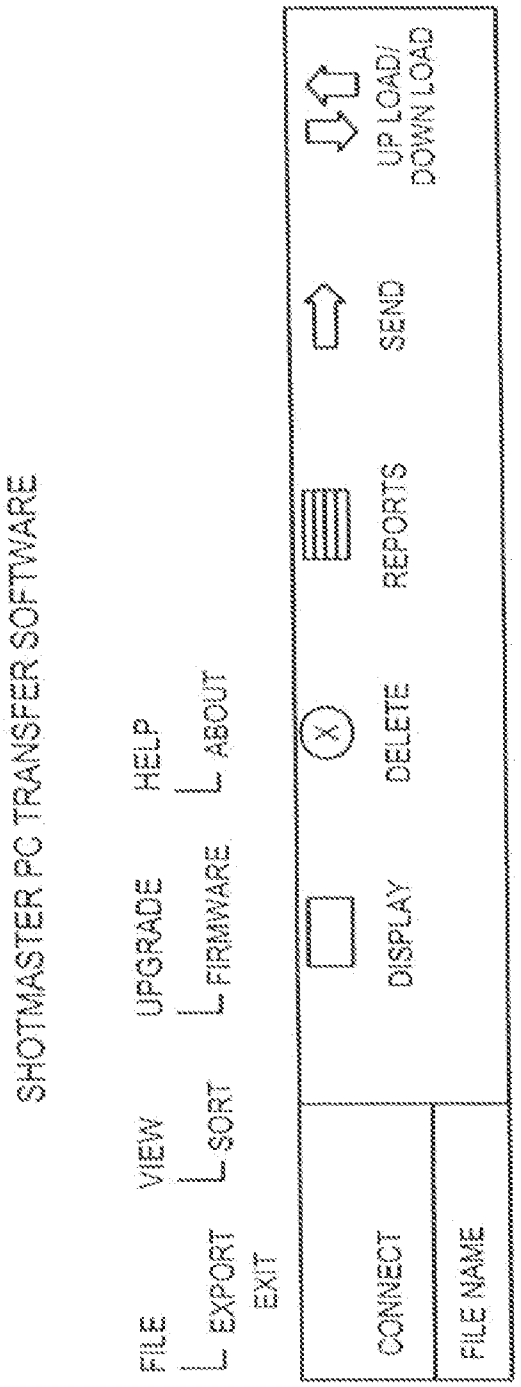
SHOTMASTER PC TRANSFER SOFTWARE
FILE
EXPORT
EXIT
VIEW
SORT
UPGRADE
FIRMWARE
HELP
ABOUT
CONNECT
DISPLAY
DELETE
REPORTS
SEND
UP LOAD/
DOWN LOAD
FILE NAME
STATUS: SHOTMASTER IS NOT CONNECTED

Fig. 9

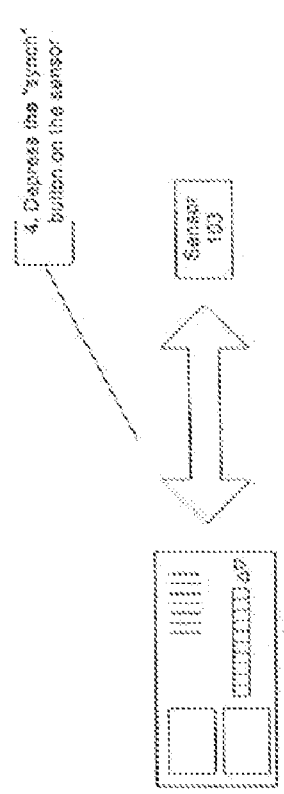

Fig. 10A

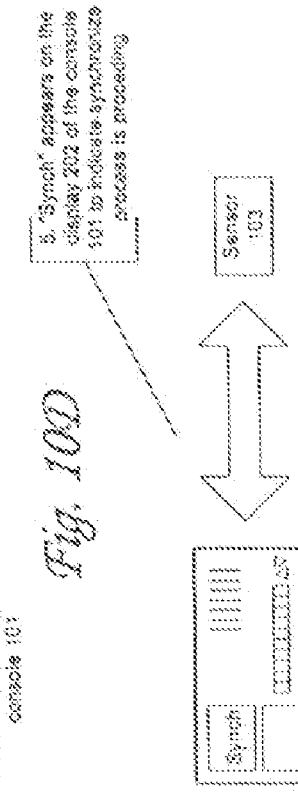

Fig. 10B

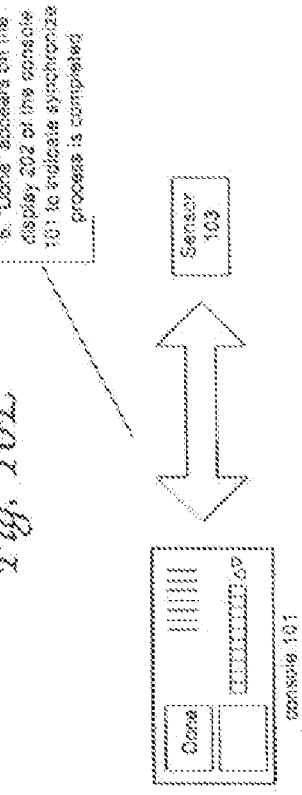

Fig. 10C

Fig. 10D

Fig. 10E

Fig. 10F

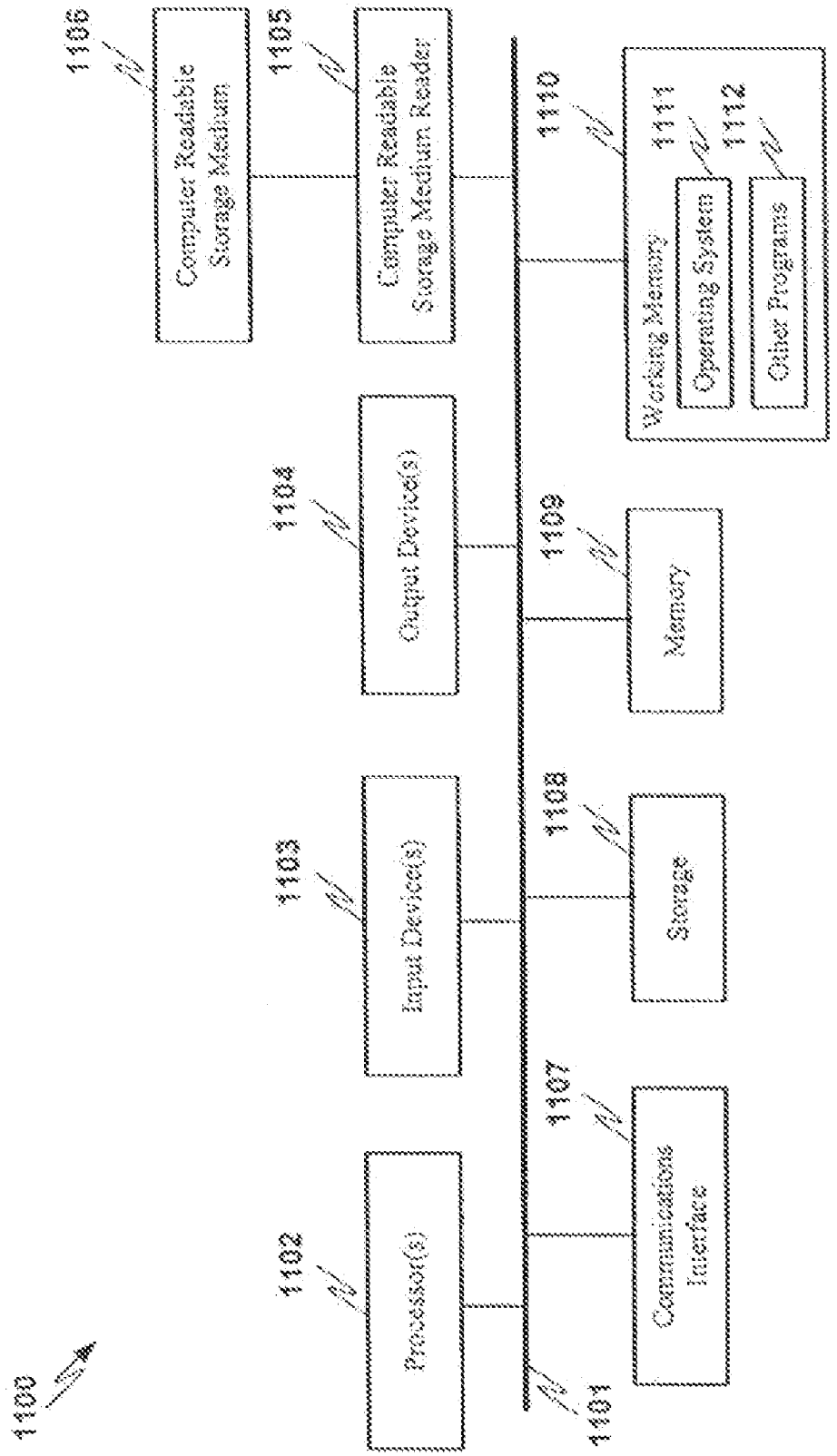
1100
1101
1102
Processor(s)
1103
Input Device(s)
1104
Output Device(s)
1105
Computer Readable Storage Medium Reader
1106
Computer Readable Storage Medium
1107
Communications Interface
1108
Storage
1109
Memory
1110
Working Memory
1111
Operating System
1112
Other Programs

Fig. 11

WIRELESS SENSOR SCORING WITH AUTOMATIC SENSOR SYNCHRONIZATION

CLAIM OF PRIORITY

[0001] This application claims the benefit of U.S. Provisional Patent Application No. 60/758,714 entitled WIRELESS SENSOR SCORING WITH AUTOMATIC SENSOR SYNCHRONIZATION, by William M. Klein, filed Jan. 13, 2006 (Attorney Docket No. KLEIN-01000US2).

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FIELD OF THE INVENTION

[0003] The current invention relates generally to measuring shooting performance, and more particularly to a mechanism for real time wireless sensor scoring.

BACKGROUND

[0004] There is an outstanding need in amateur and professional sports to identify players with the potential for development and to provide measurement and training tools to improve performance of existing players. Nowhere is this more true than in the shooting sports, such as basketball, tennis, hockey, golf and others, in which the outcome of an entire game can be determined by the performance of a single player taking a shot.

[0005] Currently, the selection, development, training and evaluation of players are almost completely dependent on the experience and observations of coaches and scouts and based upon observing actual play. These simple methods, however, lack any quantitative measure of shooting proficiency.

BRIEF DESCRIPTION OF THE DRAWINGS

[0006] FIG. **1** is functional block diagram of an example playing environment in which techniques for measuring shooting performance in one embodiment of the present invention may be implemented.

[0007] FIGS. **2**A-**2**J are block diagrams illustrating a high level overview of console apparatus for measuring shooting performance of one embodiment of the present invention.

[0008] FIGS. **3**A-**3**B are functional block diagrams of example playing environments having a plurality of superimposed cells indicating location for measuring shooting performance in one embodiment of the present invention.

[0009] FIGS. **4**A-**4**C are block diagrams illustrating a high level overview of screens displayed by a console apparatus for measuring shooting performance of one embodiment of the present invention.

[0010] FIG. **5** is functional diagram of an example encoding technique for qualifying shot types in the playing environment illustrated in FIG. **1**.

[0011] FIG. **6** is functional diagram of example historical performance measurements being tracked for a shooting session in the playing environment illustrated in FIG. **1**.

[0012] FIGS. **7**A-**7**B are operational flow diagrams illustrating a high level overview of techniques for measuring shooting performance of one embodiment of the present invention.

[0013] FIGS. **8**A-**8**C are functional diagrams of example presentations for displaying performance measurements in the playing environment illustrated in FIG. **1**.

[0014] FIG. **9** is a block diagram illustrating a high level overview of a screen displayed by a software embodiment for transferring information to and from a console apparatus of one embodiment of the present invention.

[0015] FIGS. **10**A-**10**F are block diagrams illustrating a high-level overview of an example operation of a synchronization mechanism for synchronizing the console with the sensor(s) in an embodiment of the present invention

[0016] FIG. **11** is a hardware block diagram of an example computer system, which may be used to embody one or more components of an embodiment of the present invention.

DETAILED DESCRIPTION

[0017] Embodiments provide mechanisms and methods for measuring shooting performance in multiplayer environments. These mechanisms and methods include automatic synchronization that enables sensors associated with multiple players to interact with one or more control consoles in a common playing area free of interference. The ability to associate sensors to interact with one or more control consoles in a common playing area free of interference make it possible for coaches and players to measure levels of play, build teamwork among multiple players, improve and maintain skills, select players to meet game situations and team requirements, make decisions on player roles, and use playing environment space more efficiently.

[0018] In one embodiment, the invention provides a system for measuring shooting performance. One system embodiment includes a plurality of first sensors to detect shots taken and a plurality of second sensors to determine shots made. As used herein, the term "sensor" is defined as any device for detecting an event that takes place in the shooting environment. The term sensor is intended to be broadly construed to include a single device, i.e., a detector, or a plurality of devices, i.e., an emitter and detector, and other configurations of devices. A console is communicatively coupled with the first sensor and the second sensor to receive data and determine performance of a player based at least in part on the data received. A synchronization mechanism enables the console to "learn" which sensors are being associated with the console for play. The synchronization mechanism can enable the console to determine performance exclusively for players being monitored by the sensors associated with the console. Thus, sensors associated with multiple players may interact with one or more consoles in a common playing area free of interference. Multiple sensors that determine shots taken and shots made may be associated with a single console in order to facilitate team practice.

[0019] In an embodiment, one or more location sensors are included that automatically detect the position of the player when shots are taken and record positional information along with information about the shot. This ability to obtain information to measure levels of play makes it possible to improve skills, select players to meet game situations and team requirements, and make decisions on player roles.

[0020] While the present invention is described herein with reference to example embodiments for measuring basketball players' performance, the present invention is not so limited, and in fact, the real time measurement techniques provided by embodiments of the present invention are broadly applicable to a wide variety of shooting sports. As used herein, the term shooting sports is intended to be broadly construed to include any sport in which a player makes a shot, including without limitation basketball, tennis, hockey, water polo, polo, lacrosse, golf and other shooting sports.

[0021] FIG. **1** is functional block diagram of an example playing environment in which techniques for measuring shooting performance in one embodiment of the present invention may be implemented. As shown in FIG. **1**, a performance measuring system embodiment is being used in a basketball-playing environment. The system embodiment includes a first sensor **102** to detect number of shots taken, a second sensor **103** to determine number of shots made. The first sensor includes a delay to avoid double counting the same shot when multiple triggering events occur. For example, in one embodiment, the first sensor includes a time delay, enabling the first sensor to avoid double counting the same shot from multiple vibrations of the rim or backboard. In the embodiment depicted by FIG. **1**, the first sensor **102** and second sensor **103** include a wireless RF communication link to a console **101**. The console **101** incorporates hardware, software or a combination thereof, to measure, track and record shooting session performance results. In one embodiment, the first sensor **102** is a vibration sensor that is attached to the basketball rim or backboard to detect a shot taken. In one embodiment, the second sensor includes a counter lever attached to a basketball rim or backboard to track shots made. In an alternative embodiment, the second sensor includes an opto-electronic sensor attached below the basketball rim or backboard. Proximity sensors can also be employed as well as other types of optical, electrical and mechanical sensors. Console **101** includes a synchronization mechanism that enables the console to "learn" that sensors **102** and **103** are being associated with the console **101** for play. A sensor **103** will synchronize with a console **101** through a wireless interface by holding down a particular button on the sensor and the console simultaneously for 3-5 seconds as illustrated by FIGS. **10**A-**10**F. Other sensors for detecting shots taken by another player (not shown in FIG. **1**) and shots made in another basket (not shown in FIG. **1**) may also be associated with console **101** using the synchronization mechanism. The synchronization mechanism can enable the console **101** to determine performance exclusively for players associated with the console **101** and to block interference from sensors associated with players associated with consoles other than console **101** that may be use on the same or proximate playing area.

[0022] Embodiments include one or more location sensors that automatically detect the position of the player and record positional information. In one embodiment, a pressure sensitive grid comprising a plurality of cells indicating location is disposed over the playing field in order to detect the location of the player when making a shot. In another embodiment, an infrared sensor matrix is used to superimpose a plurality of location cells comprising a grid over the playing field. In a yet further embodiment, a camera coupled with a range detection device can be used to detect the location of the player with respect to cell locations in the playing environment. Examples of cells comprising a location grid is discussed in further detail below with reference to FIGS. **3**A-**3**B.

[0023] In one embodiment, a wireless headset **104** is worn by the player during play to communicatively couple the player to the console **101**. Using voice recognition functionality in conjunction with the headset **104**, the player can input voice commands, including type of shot to be taken, number of shots to be attempted, a time period for shooting and so forth without interrupting play. Further, in one play mode, the player can call out the types of shots using the headset **104** as the player takes the shot.

[0024] In one embodiment, a video camera **105** is operatively disposed to record shots the player takes. The video camera **105** can be constantly operating or can be triggered using a command from the wireless headset **104**, a motion sensor (not shown) directed at the player, or by input of a command at the console **101** by a coach or another player.

[0025] In one embodiment, the vibration sensor and counter lever include wireless RF receiver communication links to the console **101**. The console **101** (FIGS. **2**A-**2**J) includes input keys and a display of key information for each shooting session. Various system embodiments may also include one or more of a timer, buzzer and warning device to signal the player. In one embodiment, a player or coach inputs the shooting session parameters and starts the program. When the player shoots from the specified court location, the console **101** records success or failure of each shot, along with the shot type and player location, for the desired period of time or number of shots. A warning voice projects elapsed time in one-minute increments as well as a countdown starting with 10 seconds of shooting time remaining or 10 shots left to take. The system's buzzer announces the completion of the session and the relevant performance data is displayed and saved if desired. All shot session data may be stored on a memory card and archived on a personal computer (PC) for historical analysis, review and comparison to other players. Alternatively, the console **101** can be directly linked to a computer.

[0026] FIG. **2**A-**2**J are block diagrams illustrating a high level overview of a console apparatus for measuring shooting performance of one embodiment of the present invention. The console embodiment illustrated in FIG. **2**A includes a first display area **202** that provides prompting to the player or coach using text messages, graphics, icons or a combination thereof. Example prompts for a training session are discussed below with reference to FIG. **4**A. A second display area **204** provides a view of the playing field to the player or coach. Display area **204** can be used to indicate the location from which the player takes shots. Display areas **202** and **204** may be implemented as different screens depicted on a single display in some embodiments. In one embodiment, a warning voice (not shown) projects

elapsed time in one-minute increments. Additionally, one or more input keys **208**, a reset key **210**, start key **212** and select key **214** receive commands input manually from a player or a coach. A display **206** provides key information about each shooting session to the player or coach such as presenting a countdown starting with 10 seconds of shooting time remaining or 10 shots left to take. Display **206** may be embodied using LED, LCD or other type of display technology. Various console embodiments will also include a timer, buzzer and warning device (not shown). A memory card slot **220** is provided for receiving a memory card upon which performance data may be stored. The memory card may enable the console **101** to interface with a computer to populate a database with historical performance data, prepare charts and display graphs. Alternatively, the console **101** can be directly linked to a computer using a USB port or other communications interface. FIG. **2**B illustrates another console embodiment, in which a computer style keyboard **216** provides a mechanism for a player or coach to enter information and respond to prompts. FIG. **2**C illustrates a further console embodiment, in which the shooter or coach can configure display area **204** to display one or more cells superimposed on the playing field in order to select shot locations. Cells may be arranged according to any number of arrangements, including without limitation the arrangements illustrated by FIGS. **3**A-**3**B. One or more keys **208** include alphanumeric inputs to enable players or coaches to enter player names and so forth as well as numeric data. A display **206** provides the player or coach with information and control capabilities from the console. Shooting session indicators including a shots taken display **222**, shots made display area **224**, percentage made display **226** and location display **228** present shooting session statistics to the player or coach at the end of a shooting session or in real time. A display key **216** enables the shooter or coach to display the results of the last several shooting sessions on the console **101**. Some embodiments include the capability to define a custom shooting routine or choose "random". For example, in one embodiment, a player or coach could define a three point shooting cycle by entering numbers of cells to shoot from, storing the locations in a memory and associating a code with the stored sequence. A download key **218** controls the exchange of shooting data, program updates and so forth between the console **101** and a memory card **220**, or alternatively to another computing device via a network, USB or other type of communications link. Alternative embodiments implement the functionality of console **101** as software executing on a laptop or portable computer, personal data assistant (PDA), cell phone or other wireless device, wearable personal computer worn by the player or other devices.

[**0027**] FIG. **2**D illustrates a console embodiment being used in a single player mode of operation. In the embodiment illustrated by FIG. **2**D, display **206** toggles back and forth between display options, including the clock. Illuminated button indicators, for example, can indicate what data is currently being displayed by display **206**. (e.g., in FIG. **2**D, shots take and shots made are currently being displayed.) FIG. **2**E illustrates another console embodiment, again being used in a single player mode, in which the display **206** provides a continuous clock display. FIGS. **2**F-**2**G illustrate console embodiments in a two player mode of operation. In the embodiment illustrated by FIG. **2**F, display **206** toggles back and forth between display options, including the clock, while in the embodiment illustrated by FIG. **2**G, the display **206** provides a continuous clock display. Similarly, FIGS. **2**H-**2**I illustrate console embodiments in a four player mode of operation. In the embodiment illustrated by FIG. **2**H, display **206** toggles back and forth between display options, including the clock, while in the embodiment illustrated by FIG. **2**I, the display **206** provides a continuous clock display. FIG. **2**J illustrates another console apparatus for an embodiment marketed under the name SHOTMASTER™.

[**0028**] FIGS. **3**A-**3**B are functional block diagrams of example playing environments having a plurality of superimposed cells indicating location for measuring shooting performance in one embodiment of the present invention. As shown in FIG. **3**A, in one example playing environment **300**, a plurality of cells indicating location of a player are superimposed on the playing environment. Shooting locations in playing environment **300** are arranged according to a convention in which odd numbered shooting locations are disposed to one side of the playing area and even numbered shooting locations are on the opposite side of the playing area. Of course, in some embodiments, odd and even numbered cells may be on opposite sides from the ones illustrated in FIG. **3**A. Such naming conventions of shooting locations are provided by embodiments of the present invention in order to facilitate easier player (or coach) identification of the player locations. Further, playing environment **300** includes cells having different sizes in areas considered to be of special interest to the player or relevance to scoring in the particular shooting sport under practice, such as the foul line or the 3 point line in basketball, for example. Another consideration for shooting location identification is compliance with governing body, i.e., NBA, etc., rules or international governing body, i.e., Olympic Committee, rules. FIG. **3**B illustrates another example playing environment **302**, in which the plurality of cells indicating location of a player is arranged according to international rules. Each shooting location can vary in size and/or area and may be identified by a number, letter, color, combination thereof or other conventions that are contemplated.

[**0029**] Shooting location detection may be achieved using various techniques in embodiments of the present invention. For example, in one embodiment, a pressure sensitive grid comprising a plurality of cells indicating location is disposed over the playing field in order to detect the location of the player when making a shot. Such techniques are especially useful when cells vary in size and shape, such as the embodiments illustrated by FIGS. **3**A-**3**B. In another embodiment, an infrared sensor matrix is used to superimpose a plurality of location cells comprising a grid over the playing environment. In this embodiment, a device that includes an infrared sensor and an infrared light source produces pulses of infrared light and uses optics to focus reflections from the infrared light pulse from different portions of the playing environment to different detectors in a 2-D array detector. The detector produces indications of the distance to the closest object in an associated portion of the playing environment. A processor receives the indication of the infrared sensor to determine the player location. An exemplary infrared sensor for use in the present invention is available from Canesta, Inc. of San Jose, Calif. Details of such infrared sensors are described in the U.S. Pat. No. 6,323,932 and published patent applications US 2002/0140633 A1, US 2002/0063775 A1, US 2003/0076484 A1

each of which are incorporated herein by reference. Such techniques are especially useful when cells are of uniform size and shape. In a further embodiment computer touch screen techniques can be used. In a yet further embodiment, a camera **105** coupled with a range detection device can be used to detect location of the player with respect to cell locations on the playing environment. Such techniques are especially useful when cell location may be determined using a range, such as the embodiments illustrated by FIGS. **3**A-**3**B. The player location determined by any one of these techniques may be stored along with other data about the shot.

[**0030**] FIGS. **4**A-**4**C are block diagrams illustrating a high level overview of screens displayed by a console **101** for measuring shooting performance of one embodiment of the present invention. As shown by FIG. **4**A, one or more prompts may be displayed in display area **202** of console **101** to prompt a player or coach to input one or more parameters for the shooting session. In the embodiment illustrated by FIG. **4**A, the player (or a coach) inputs a number of shooters, the appropriate court location, shot type, desired period of time and/or number of shots, and presses the start key **212** to initiate the program. In an alternative embodiment, the prompts shown in FIG. **4**A may be provided to the player audibly via headset **104**, and the player's responses received and analyzed using voice recognition processing to obtain responses from the player, thereby providing a "hands free" mode of operation.

[**0031**] An "Automatic synchronization" facility enables multi-player competition mode, in which multiple sets of sensors can be associated with a particular console to encourage team practice. FIG. **4**B illustrates another example screen displayed by a console **101** in which a multi-sensor automatic synchronization mode is provided. As shown in FIG. **4**B, in synchronize mode, the number of sensors to be associated with a particular console may be entered responsive to the prompts. As shown by FIG. **4**B, the console display prompts the user to activate a synchronization mechanism at each sensor to be associated with the console **101** successively. A sensor will synchronize with a console through a wireless interface by holding down a particular button on the sensor and the console simultaneously for 3-5 seconds as illustrated by FIGS. **10**A-**10**F. When the console **101** has identified each sensor that is being assigned to it, the console displays a "synchronization complete" message. Automatic synchronization can enable multiple consoles to interact with sensors in a common playing area free of interference. FIG. **4**C illustrates an example shooting session summary screen displayed in display area **202** or **204** of console **101** after a player completes a shooting session. As shown in FIG. **4**C, shooting session summary statistics may be presented to the player or coach in a format emulating a basketball (or other sport) scoreboard. Other embodiments will display the output using other formats appropriate to the shooting sport being practiced.

[**0032**] Encoding schemes may be used in some embodiments to simplify storage of shot types in databases or other storage mechanisms. For example, FIG. **5** is a functional diagram of an example encoding technique for qualifying shot types in the playing environment illustrated in FIG. **1**. As shown by FIG. **5**, an encoding scheme can associate a number with a shot type. Such encoding techniques can enable analysis based upon statistics developed for different shot types and in certain cases simplify storage of historical shooting session information. While FIG. **5** illustrates one encoding scheme for basketball, other embodiments will employ other encoding techniques appropriate to the shooting sport being practiced.

[**0033**] FIG. **6** is functional diagram of example historical performance measurements being tracked for a shooting session in the playing environment illustrated in FIG. **1**. The example table illustrated in FIG. **6** includes a list of parameters describing the results of a basketball shooting session in one embodiment. Various mechanisms for storing and tracking parameter data gathered from shooting sessions are made available in embodiments. For example, in one embodiment, a database is used to store and organize parameter information, such as shown by FIG. **6**. Other embodiments will employ other storage and organization techniques, and store different parameters, appropriate to the shooting sport being practiced.

[**0034**] FIGS. **7**A-**7**B are operational flow diagrams illustrating a high level overview of techniques for measuring shooting performance of one embodiment of the present invention. The technique for measuring shooting performance shown in FIGS. **7**A-**7**B are operable with console **101** of FIGS. **2**A-**2**J. As show in FIG. **7**A, a user causes a console to synchronize with one or more sensors (block **701**). Then, the player enters shooting session parameters at the console (block **702**) as described in further detail with reference to FIG. **7**B. The player(s) may now perform the shooting session (block **703**). As shown in FIG. **7**B, a player enters the number of shooters (block **711**). The player enters his shooter id number (or name) (block **712**). The player selects the number of shots to take or a period of time to shoot (block **713**). The player selects a shot location cell (block **714**). As described above, some embodiments will automatically determine the location from which the shot is made. The player selects the type of shot (block **715**). The player presses a start key to begin play (block **716**). The player can then take the shots (block **717**). Once the session is complete, the system automatically determines and displays results of the session, in the form of session statistics, to the player (block **718**). Some embodiments include different operational characteristics, such as, for example automatically determining the shot location using one of the techniques described above instead of receiving it from the player (block **714**) or receiving the type of shot via headset **104** to accommodate "hands-free" operation (block **715**) and so forth.

[**0035**] FIGS. **8**A-**8**C are functional diagrams of example presentations for displaying performance measurements in the playing environment illustrated in FIG. **1**. As shown in FIG. **8**A, shooting session historical performance measurements may be presented to the player or coach in display area **202** or **204** of console **101**. Other types of reports can be provided to assist the player or coach in evaluating the results of play. For example, FIG. **8**B illustrates an example of a report organized by week. Table 1 illustrates other types of reports provided by various embodiments:

TABLE 1

Reports by Type

Report Type	Reports
Calendar	1. Weekly summary by day
	2. Monthly summary by week
	3. Yearly summary by month
	4. Cumulative by shooter
Location	1. All shot types
	2. By shot type
	3. Summary for 3 pointers
Shot type	1. All locations
	2. By location
	3. Summary for 3 pointers
Summaries	1. Top 10 shooting sessions by % made (by date)
	2. Top 10 shooting locations (location)
	3. Top 10 shot types (type)
	4. Top 10 shot types by location (type/loc.)

[0036] Some embodiments provide the capability to view the results of play in graph or other tabular formats. For example, FIG. **8**C illustrates an example of a graph for providing results of play in graphical format. Other embodiments will display other statistics appropriate to the shooting sport being practiced.

[0037] FIG. **9** is a block diagram illustrating a high level overview of a screen displayed by a software embodiment for transferring information to and from a console apparatus of one embodiment of the present invention. As shown in FIG. **9**, console **101** can include software that enables a variety of functions, including without limitation: 1) Connect/interface the console **101** with a PC via a USB port or other communications interface; 2) Display performance data in a variety of formats, such as illustrated by FIGS. **8**A-**8**C; 3) Download performance data to the PC; 4) Enable automatic generation of standardized performance data reports; 5) Provide for upload of firmware upgrades; 6) Allow performance data to be sent via email; 7) Transfer status information about operation of the console **101** and associated hardware and software back to manufacturer. Table 2 illustrates other types of menu options provided in an embodiment:

TABLE 2

Menu Options

Pull down menus	Sub-menus
5. Enter shooter I.D.	
6. Select shot location	All shot types
	By shot type
	Summary for 3 pointers
7. Select shot type	All locations
	By location
	Summary for 3 pointers
8. Select calendar/dates	Cumulative
	Annual
	Monthly
	Weekly
9. Select report type	Standard
	Top 10 shooting sessions
	Top 10 shot locations
	Top 10 shot types by location

[0038] Various embodiments will include other functions readily apparent to persons skilled in the art but not mentioned here for brevity.

[0039] In one embodiment, a path made by the ball during a shot is tracked by the console **101**. The path information may be used to locate the ball as it goes through the hoop or may be used to track the path of the ball in order to analyze the shooter's technique. One technique for tracking the ball path during play involves adding a radio frequency identification ("RFID") chip to the ball. The RFID chip can signal a tracking unit integrated into or cooperatively coupled with the console **101**, enabling the console **101** to track the path of the ball. In another technique, the video camera **105** and image processing software may be used to track the path of the ball during the shot. An exemplary arc tracking analyzer for use in the present invention is available from Pillar Vision, Inc. of Menlo Park, Calif. (www.noahbasketball.com) and by Radar Golf, Inc. of Roseville, Calif. (www.radargolf.com).

[0040] FIGS. **10**A-**10**F are block diagrams illustrating a high-level overview of an example operation of a synchronization mechanism for synchronizing the console with the sensor(s) in an embodiment of the present invention. The console and each sensor will be synchronized with each other electronically. The purpose of the synchronization function is to uniquely identify a sensor with a console to allow one to one communication between the synchronized components. In one embodiment, a console **101** may communicate with up to four (4) unique sensors but a sensor should only communicate with one console at a time. A sensor will synchronize with a console through a wireless interface by holding down a particular button on the sensor and the console simultaneously for 3-5 seconds as illustrated by FIGS. **10**A-**10**F.

[0041] In other aspects, the invention encompasses in some embodiments, computer apparatus, computing systems and machine-readable media configured to carry out the foregoing methods. In addition to an embodiment consisting of specifically designed integrated circuits or other electronics, the present invention may be conveniently implemented using a conventional general purpose or a specialized digital computer or microprocessor programmed according to the teachings of the present disclosure, as will be apparent to those skilled in the computer art.

[0042] Appropriate software coding can readily be prepared by skilled programmers based on the teachings of the present disclosure, as will be apparent to those skilled in the software art. The invention may also be implemented by the preparation of application specific integrated circuits or by interconnecting an appropriate network of conventional component circuits, as will be readily apparent to those skilled in the art.

[0043] The present invention includes a computer program product which is a storage medium (media) having instructions stored thereon/in which can be used to program a computer to perform any of the processes of the present invention. The storage medium can include, but is not limited to, any type of rotating media including floppy disks, optical discs, DVD, CD-ROMs, microdrive, and magneto-optical disks, and magnetic or optical cards, nanosystems (including molecular memory ICs), or any type of media or device suitable for storing instructions and/or data.

[0044] Stored on any one of the computer readable medium (media), the present invention includes software for controlling both the hardware of the general purpose/specialized computer or microprocessor, and for enabling the computer or microprocessor to interact with a human user or other mechanism utilizing the results of the present invention. Such software may include, but is not limited to, device drivers, operating systems, and user applications.

[0045] FIG. **11** illustrates an exemplary processing system **900**, which can comprise the console **101** of FIGS. **2**A-**2**J. Turning now to FIG. **11**, an exemplary computing system is illustrated that may comprise the console **101** of FIGS. **2**A-**2**J. While other alternatives might be utilized, it will be presumed for clarity sake that components of the systems of FIGS. **2**A-**2**J are implemented in hardware, software or some combination thereof in at least one embodiment.

[0046] Computing system **1100** comprises components coupled via one or more communication channels (e.g., bus **1101**) including one or more general or special purpose processors **1102**, such as a Pentium®, Centrino®, Power PC®, digital signal processor ("DSP"), and so on. System **1100** components also include one or more input devices **1103** (such as a mouse, keyboard, microphone, pen, and so on), and one or more output devices **1104**, such as a suitable display, speakers, actuators, and so on, in accordance with a particular application. (It will be appreciated that input or output devices can also similarly include more specialized devices or hardware/software device enhancements suitable for use by the mentally or physically challenged.)

[0047] System **1100** also includes a computer readable storage media reader **1105** coupled to a computer readable storage medium **1106**, such as a storage/memory device or hard or removable storage/memory media; such devices or media are further indicated separately as storage **1108** and memory **1109**, which may include hard disk variants, floppy/compact disk variants, digital versatile disk ("DVD") variants, smart cards, read only memory, random access memory, cache memory, and so on, in accordance with the requirements of a particular application. One or more suitable communication interfaces **1107** may also be included, such as a modem, DSL, infrared, RF or other suitable transceiver, and so on for providing inter-device communication directly or via one or more suitable private or public networks or other components that may include but are not limited to those already discussed.

[0048] Working memory **1110** further includes operating system ("OS") **1111** elements and other programs **1112**, such as one or more of application programs, mobile code, data, and so on for implementing system **1100** components that might be stored or loaded therein during use. The particular OS or OSs may vary in accordance with a particular device, features or other aspects in accordance with a particular application (e.g. Windows, WindowsCE, Mac, Linux, Unix or Palm OS variants, a cell phone OS, a proprietary OS, Symbian, and so on). Various programming languages or other tools can also be utilized, such as those compatible with C variants (e.g., C++, C#), the Java 2 Platform, Enterprise Edition ("J2EE") or other programming languages in accordance with the requirements of a particular application. Other programs **1112** may further, for example, include one or more of activity systems, education managers, education integrators, or interface, security, other synchronization, other browser or groupware code, and so on, including but not limited to those discussed elsewhere herein.

[0049] When implemented in software (e.g. as an application program, object, agent, downloadable, servlet, and so on in whole or part), a learning integration system or other component may be communicated transitionally or more persistently from local or remote storage to memory (SRAM, cache memory, etc.) for execution, or another suitable mechanism can be utilized, and components may be implemented in compiled or interpretive form. Input, intermediate or resulting data or functional elements may further reside more transitionally or more persistently in a storage media, cache or other volatile or non-volatile memory, (e.g., storage device **1108** or memory **1109**) in accordance with a particular application.

[0050] Other features, aspects and objects of the invention can be obtained from a review of the figures and the claims. It is to be understood that other embodiments of the invention can be developed and fall within the spirit and scope of the invention and claims. The foregoing description of preferred embodiments of the present invention has been provided for the purposes of illustration and description. It is not intended to be exhaustive or to limit the invention to the precise forms disclosed. Many modifications and variations will be apparent to the practitioner skilled in the art. The embodiments were chosen and described in order to best explain the principles of the invention and its practical application, thereby enabling others skilled in the art to understand the invention for various embodiments and with various modifications that are suited to the particular use contemplated. It is intended that the scope of the invention be defined by the following claims and their equivalence.

1. A shooting sports measurement system, comprising:

a plurality of first sensors to detect shots taken by a plurality of players,

a plurality of second sensors to determine shots made by the plurality of players,

a console, the console communicatively coupled with the plurality of first sensors and the plurality of second sensors to receive data and determine performance of at least one player based at least in part on the data received; and

a synchronization mechanism to enable the console to learn which of the plurality of first sensors and the plurality of second sensors are associated with the console, thereby enabling the console to determine performance exclusively for players being monitored by the sensors associated with the console.

2. The system of claim 1, further comprising a detection mechanism that detects a position of a player when the player takes a shot, the console determining performance of at least one player based at least in part on information received from the detection mechanism that detects a position of a player.

3. The system of claim 1, wherein the first sensor comprises a vibration sensor adapted to be attached to the basketball rim or backboard to detect a shot taken.

4. The system of claim 1, wherein the second sensor comprises at least one of an optoelectronic sensor or a

counter lever, adapted to be attached to the basketball rim or backboard to determine number of shots made at a specified location.

5. The system of claim 1, wherein the console acts as an input and output device for each shooting session.

6. The system of claim 1, wherein the console includes a time display, wherein the time display is selectively enabled to be at least one of continuously displayed and displayed alternating with display of play information.

7. The system of claim 2, wherein the detection mechanism that detects position of a player making shots comprises:

an infrared sensor that automatically detect a player's position using a 2-D grid.

8. The system of claim 2, wherein the detection mechanism that detects position of a player making shots comprises:

a pressure sensor grid disposed at least a portion of a playing field.

9. The system of claim 2, wherein the detection mechanism that detects position of a player making shots comprises:

a camera with a ranging device.

10. The system of claim **29** further comprising:

a plurality of cells superimposed onto at least a portion of a playing field, wherein the plurality of cells indicates a player's position when a shot is taken.

11. The system of claim 10, wherein the plurality of cells superimposed onto at least a portion of a playing field further comprises:

a plurality of cells of varying sizes according to relevance to scoring in the shooting sport under practice superimposed onto at least a portion of a playing field.

12. The system of claim 10, wherein the plurality of cells superimposed onto at least a portion of a playing field further comprises:

a plurality of cells associated with an alphanumeric naming convention facilitating ease of use superimposed onto at least a portion of a playing field.

13. The system of claim 10, wherein the plurality of cells superimposed onto at least a portion of a playing field further comprises:

a plurality of cells arranged according to a playing rule superimposed onto at least a portion of a playing field.

14. The system of claim 10, wherein the plurality of cells superimposed onto at least a portion of a playing field further comprises:

a plurality of cells arranged according to an international playing rule superimposed onto at least a portion of a playing field.

15. The system of claim 1, further comprising:

a video device for capturing a video record of a player taking a shot, wherein the video device is triggered when a shot is taken.

16. The system of claim 1, further comprising:

a wireless headset for capturing a audio commands from a player taking a shot, wherein the audio commands control recording of information about the shot.

17. The system of claim 2, wherein the detection mechanism includes visual player location indicia that are adapted to be viewed by a console operator such that the console operator can manually enter the indicia into the console.

18. A computer based method for measuring shooting sports performance, the method comprising the computer implemented steps of:

determining whether a shot is made;

synchronizing the shot with one of a plurality of players;

determining a location of the player taking the shot when the shot is taken;

receiving information about the player; and

determining performance of the player based on the determining steps.

19. A shooting sports measurement system, comprising:

a sensor to determine shots made,

a detection mechanism that detects a position of a player when the player takes a shot;

a console, the console communicatively coupled with the sensor and the detection mechanism to receive data and determine performance of a player; and

a synchronization mechanism to associate the sensors with the console, thereby enabling the console to determine performance exclusively for players being monitored by the sensors.

20. The system of claim 19, wherein the detection mechanism includes visual player location indicia that is adapted to be viewed by a console operation, such that console operator can manually enter the location into the console.

21. The system of claim 19 wherein the detection mechanism automatically detects a position of a player when the player take a shot.

22. The system of claim 19 wherein the detection mechanism automatically detects a position of a player when the player takes a shot.

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