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(54) **BASKETBALL TRAINING SYSTEM AND METHOD**

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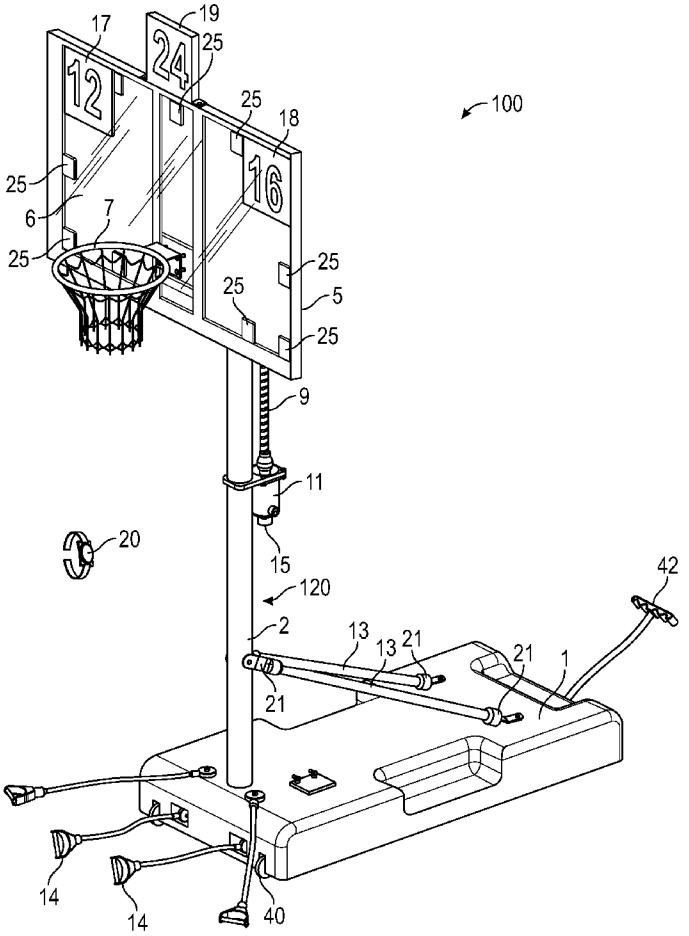
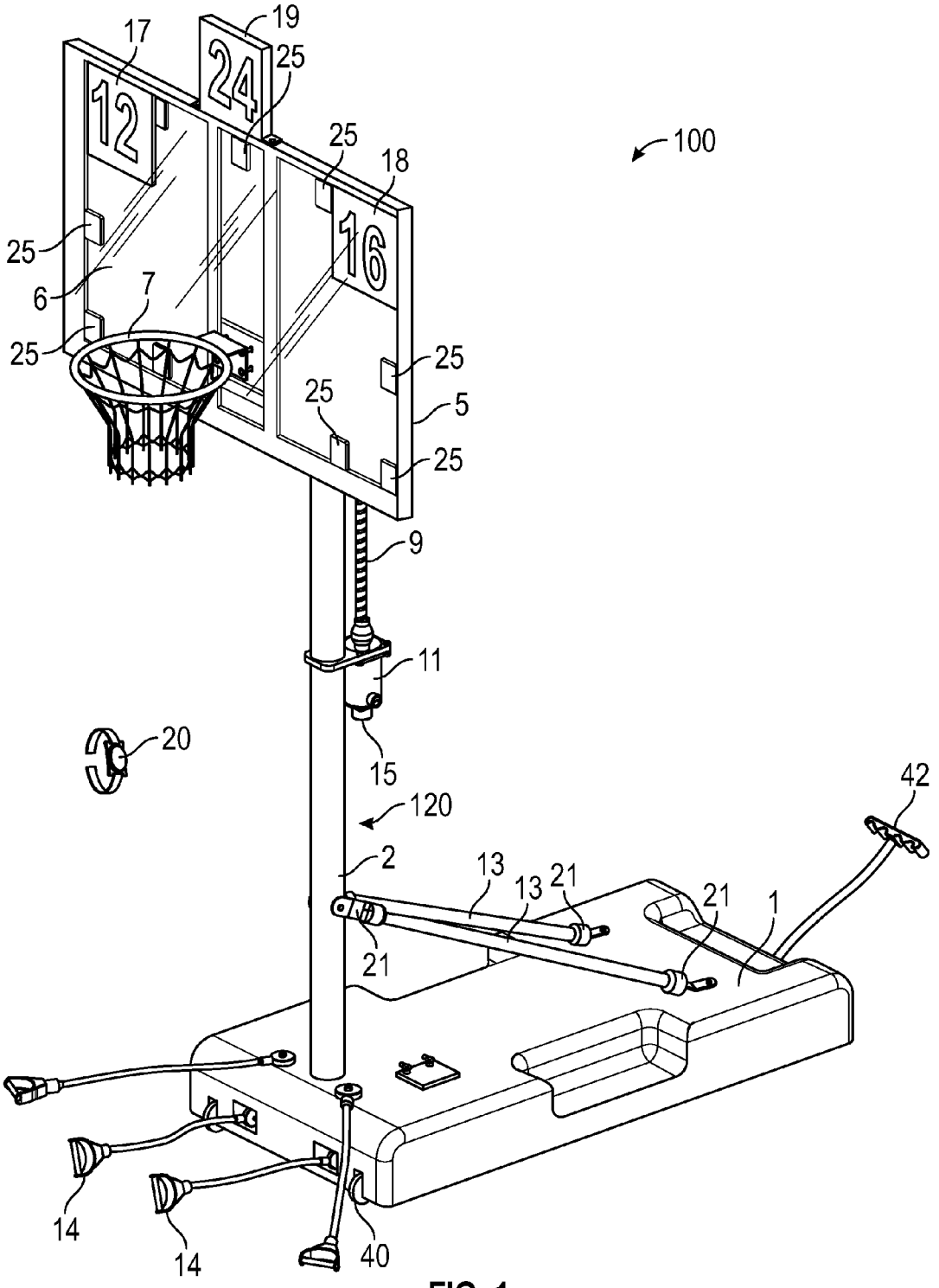
(57) **ABSTRACT**

A basketball training system has one or more mobile wireless communication devices for wearing or carrying by players, a backboard carrying a basketball hoop, a video camera associated with the backboard for collecting video of basketball training and transmitting the collected video to a processing device integral with or separate from the mobile device, and motion sensors mounted around the backboard for detecting shot attempts and providing shot attempt data to the device or processing unit. Distance and position of the mobile device relative the backboard is collected for each shot. Score information is detected by sensors or input by the user on the mobile device when a shot is made. An application associated with the processing unit calculates and stores shot and score data and associated position data and calculates shot percentages at different shot locations relative to the backboard for later review by the player or coach.




100
17
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6
7
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25
5
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9
11
20
15
120
42
2
13
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21
21
21
1
14
14
40

FIG. 1

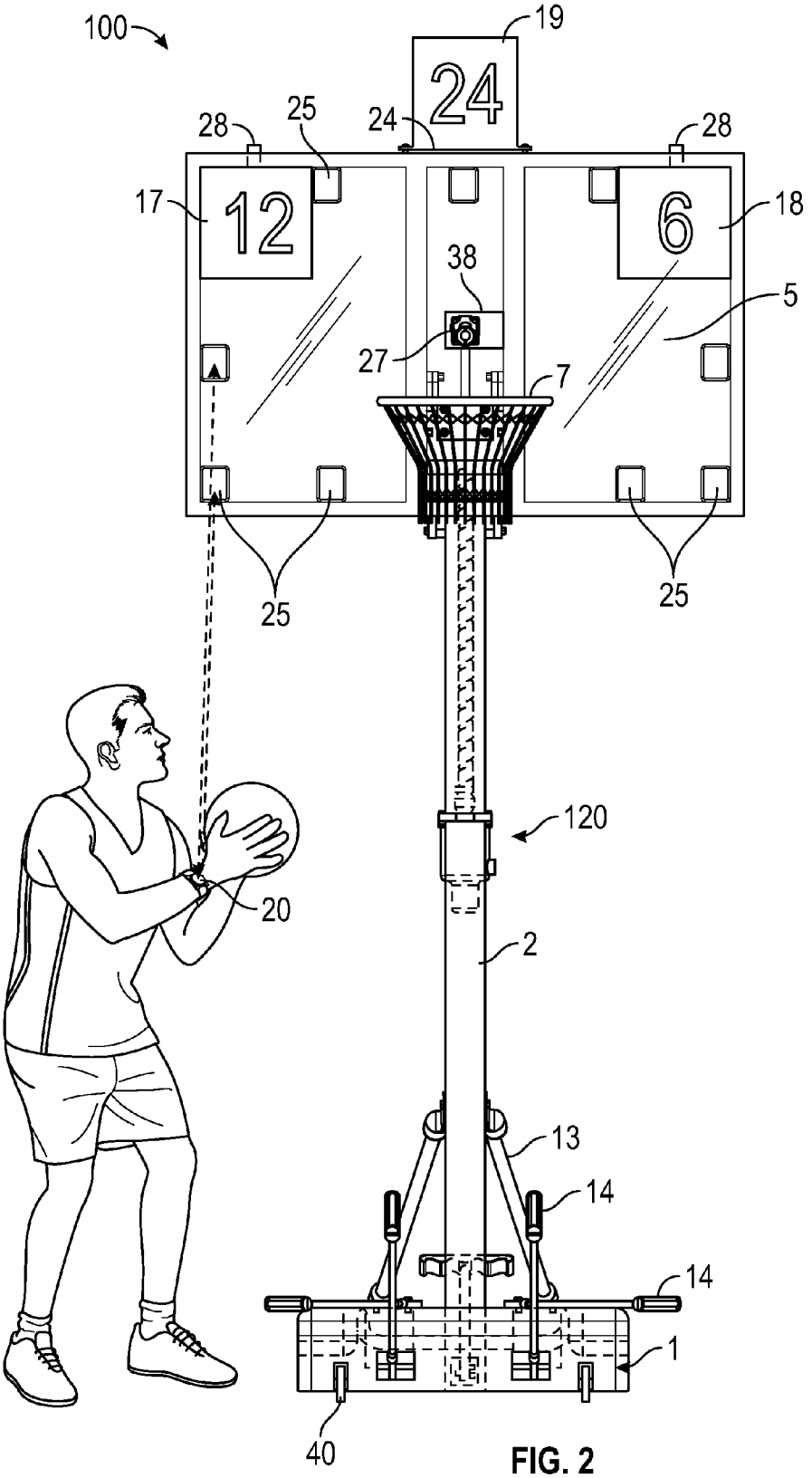

FIG. 2

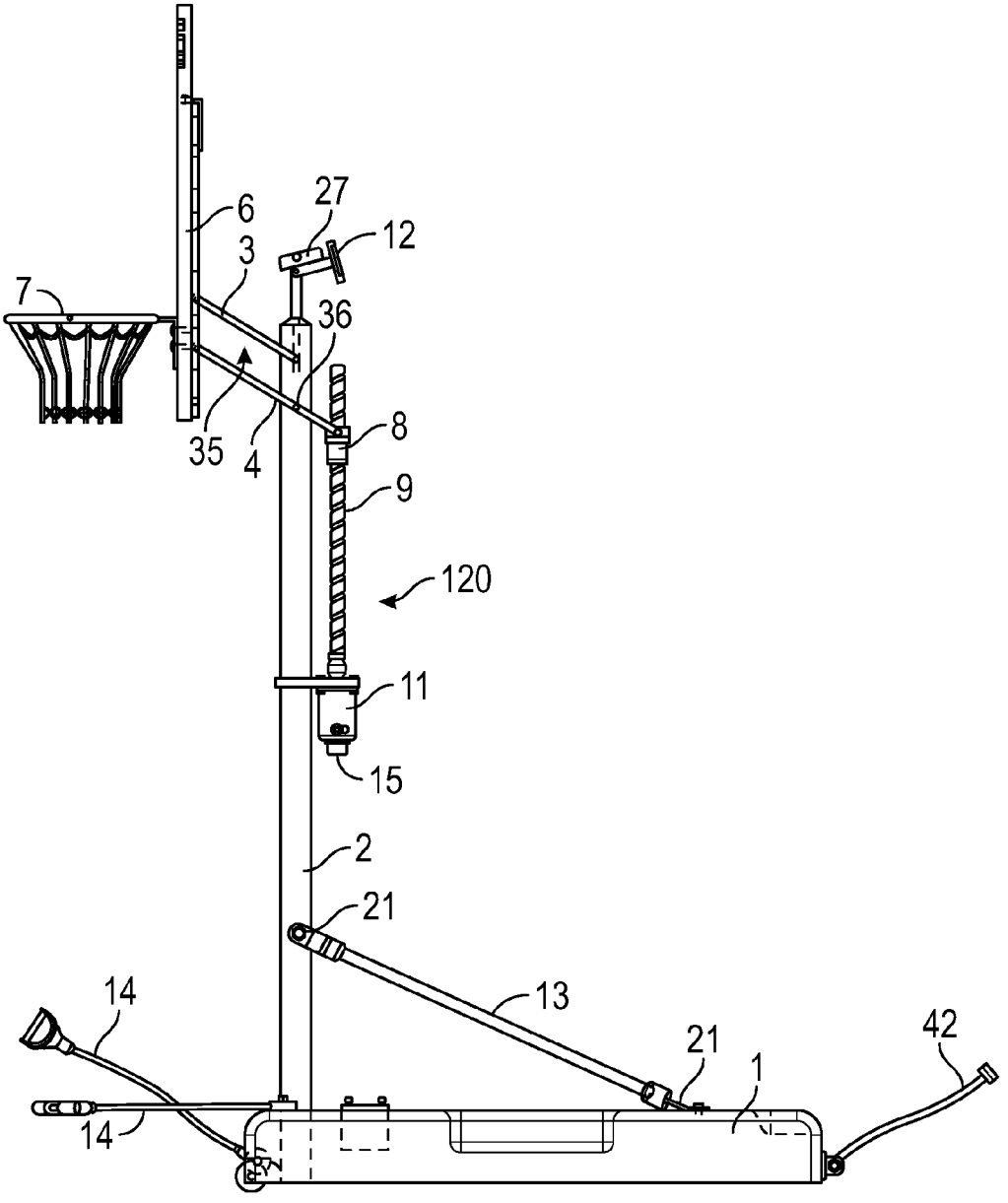

FIG. 3

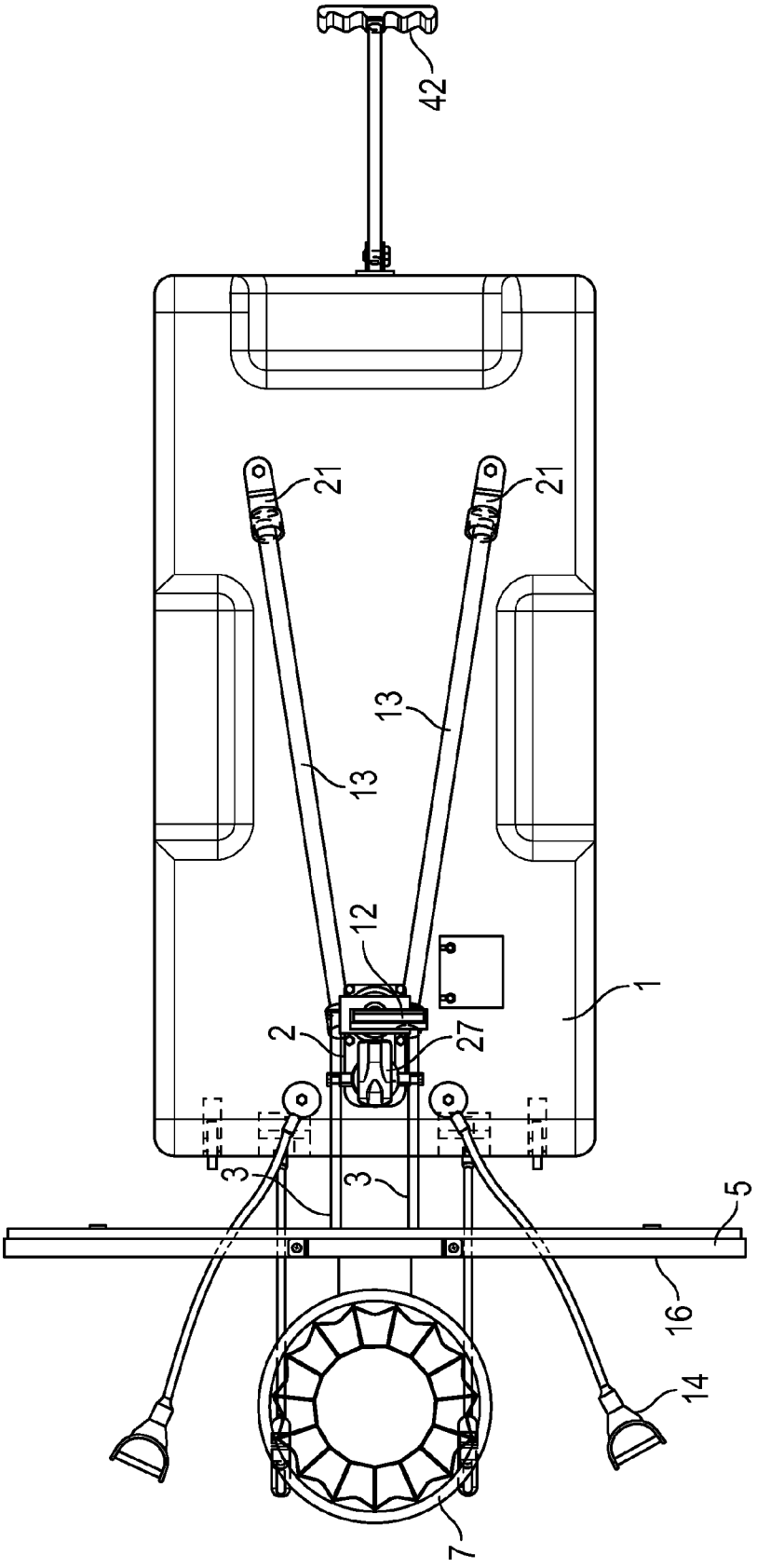

FIG. 4

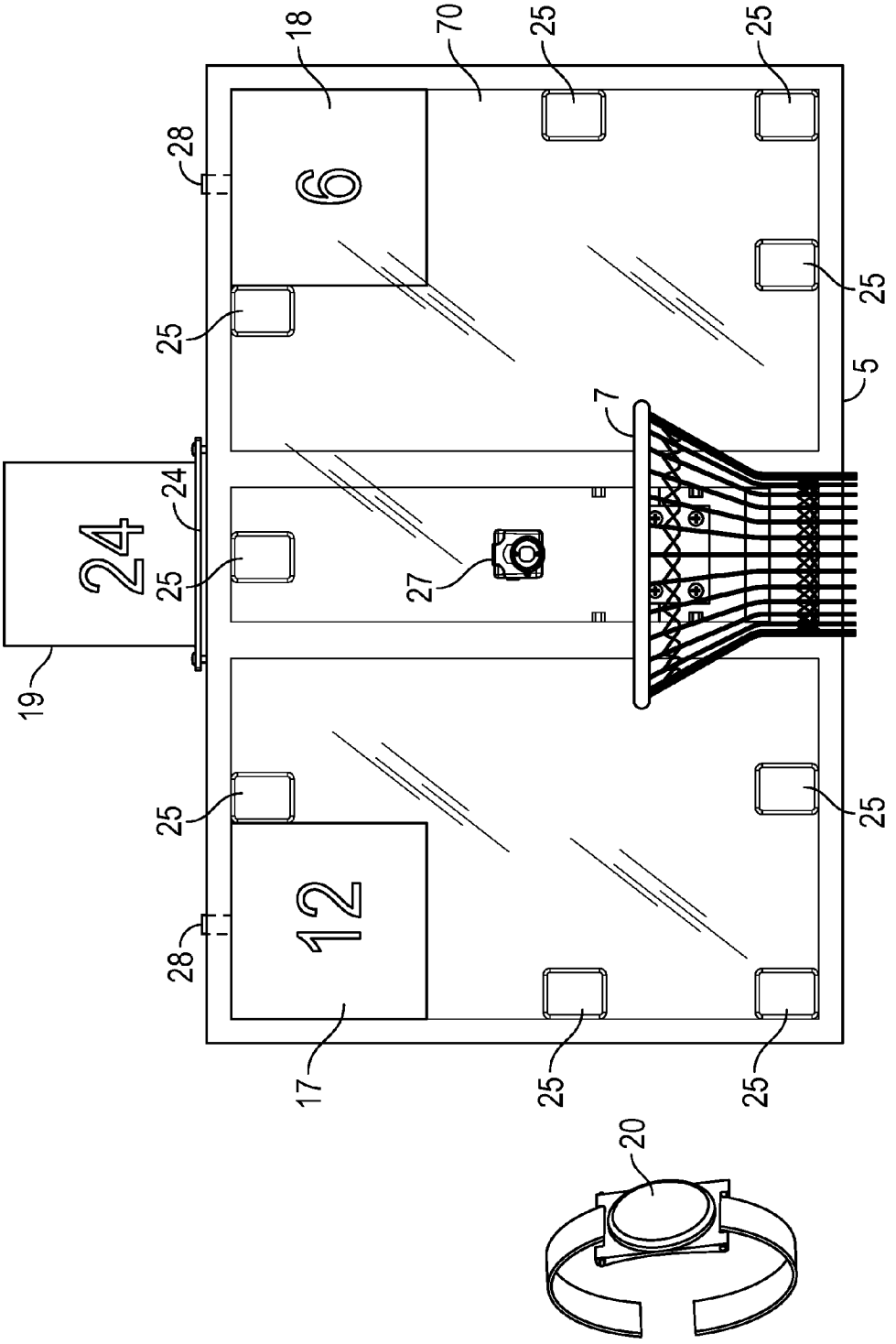

FIG. 5

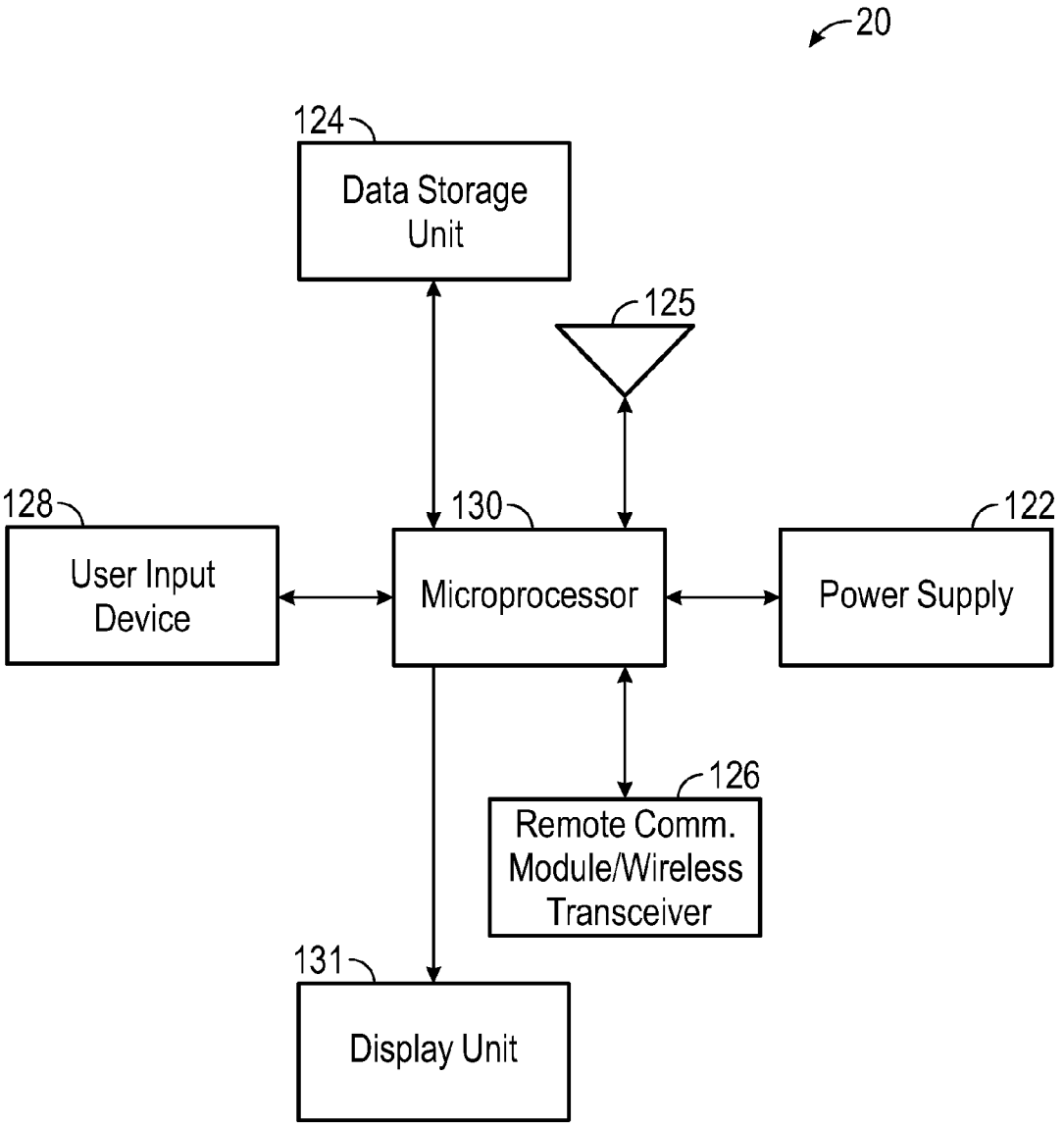
20
124
Data Storage Unit
125
128
User Input Device
130
Microprocessor
122
Power Supply
126
Remote Comm. Module/Wireless Transceiver
131
Display Unit

FIG. 6

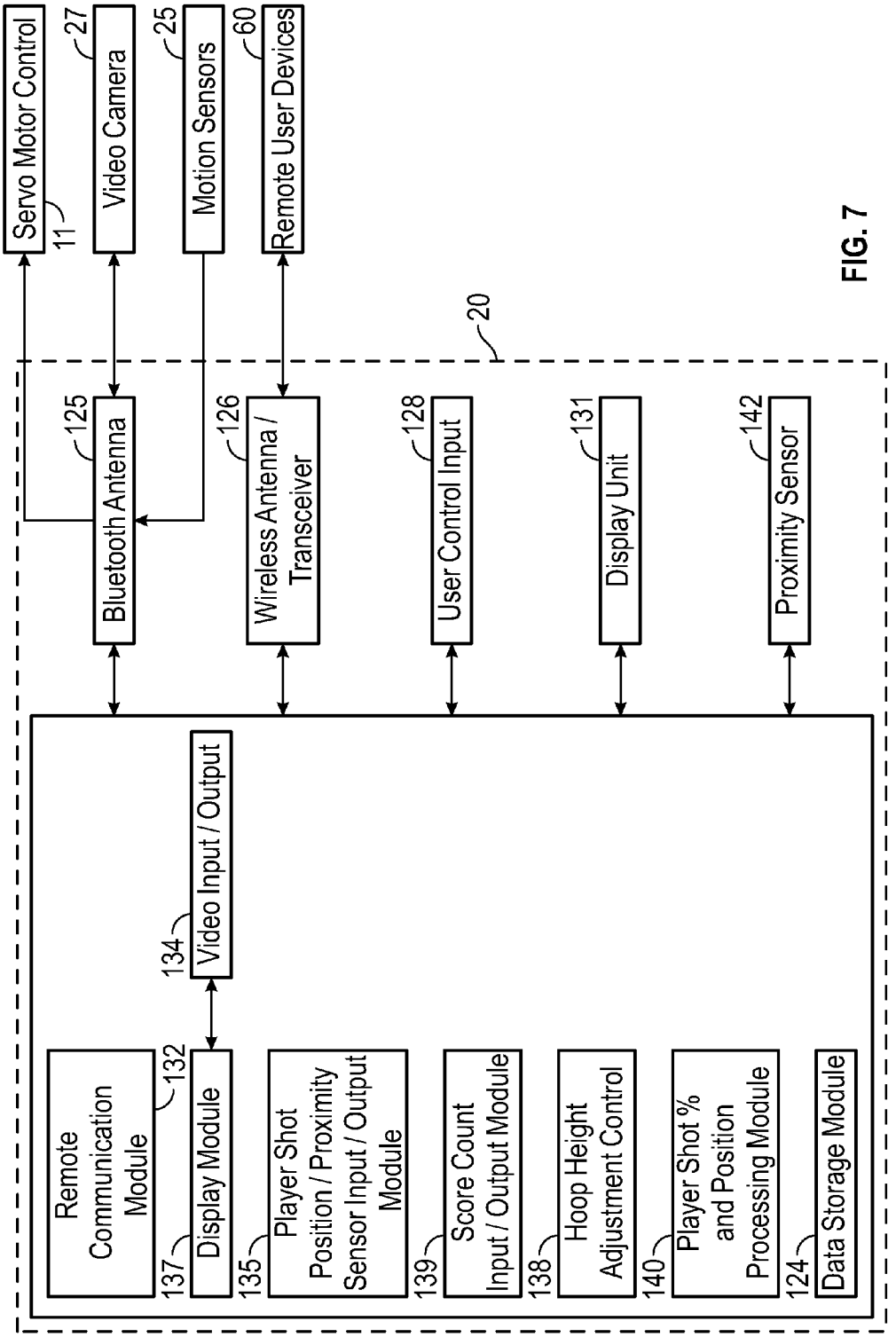
Servo Motor Control
11
Video Camera
27
Motion Sensors
25
Remote User Devices
60
20
Bluetooth Antenna
125
Wireless Antenna / Transceiver
126
User Control Input
128
Display Unit
131
Proximity Sensor
142
Video Input / Output
134
Remote Communication Module
132
Display Module
137
Player Shot Position / Proximity Sensor Input / Output Module
135
Score Count Input / Output Module
139
Hoop Height Adjustment Control
138
Player Shot % and Position Processing Module
140
Data Storage Module
124

FIG. 7

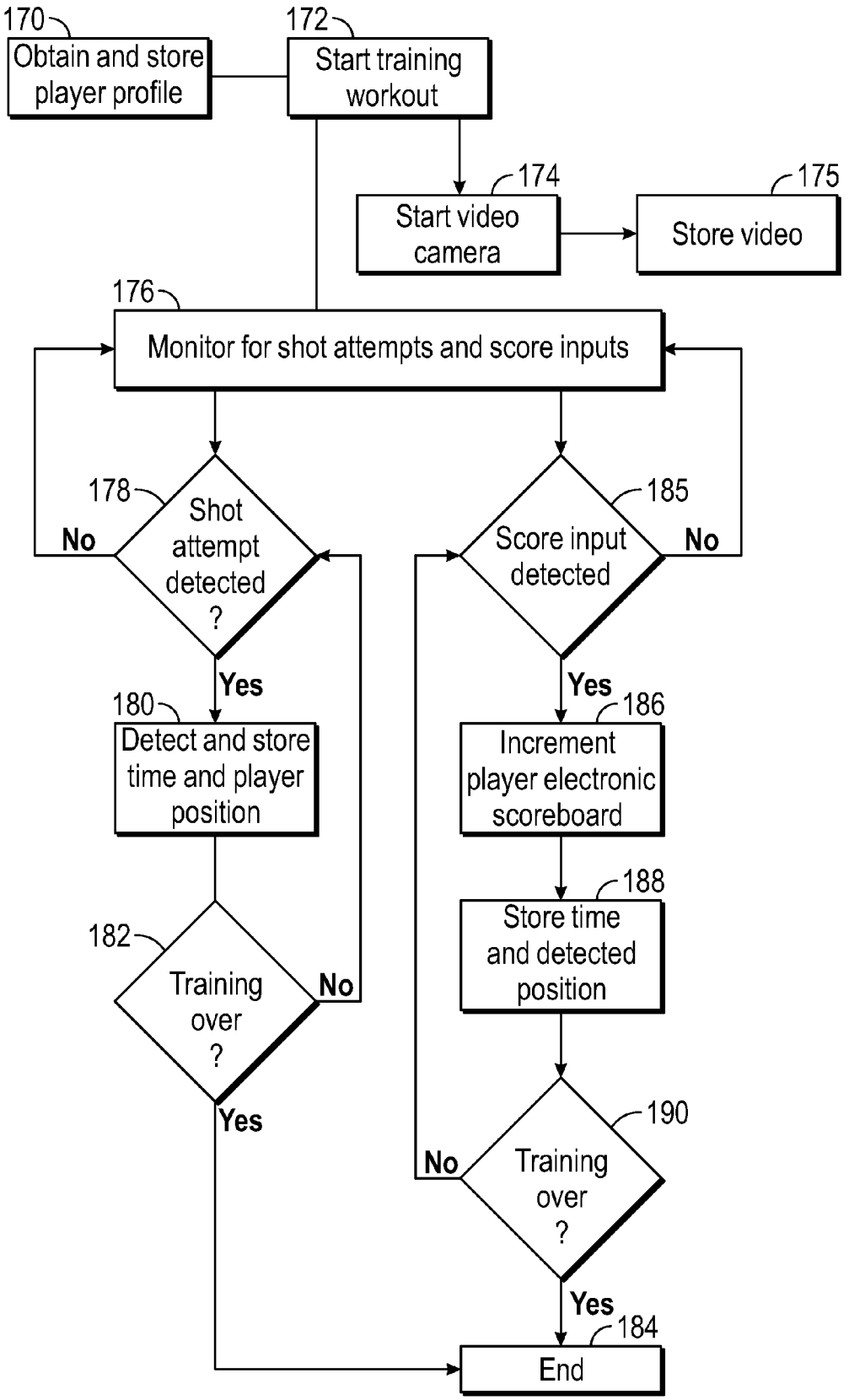
170
Obtain and store player profile
172
Start training workout
174
Start video camera
175
Store video
176
Monitor for shot attempts and score inputs
178
Shot attempt detected ?
No
Yes
180
Detect and store time and player position
182
Training over ?
No
Yes
185
Score input detected
No
Yes
186
Increment player electronic scoreboard
188
Store time and detected position
190
Training over ?
No
Yes
184
End

FIG. 8

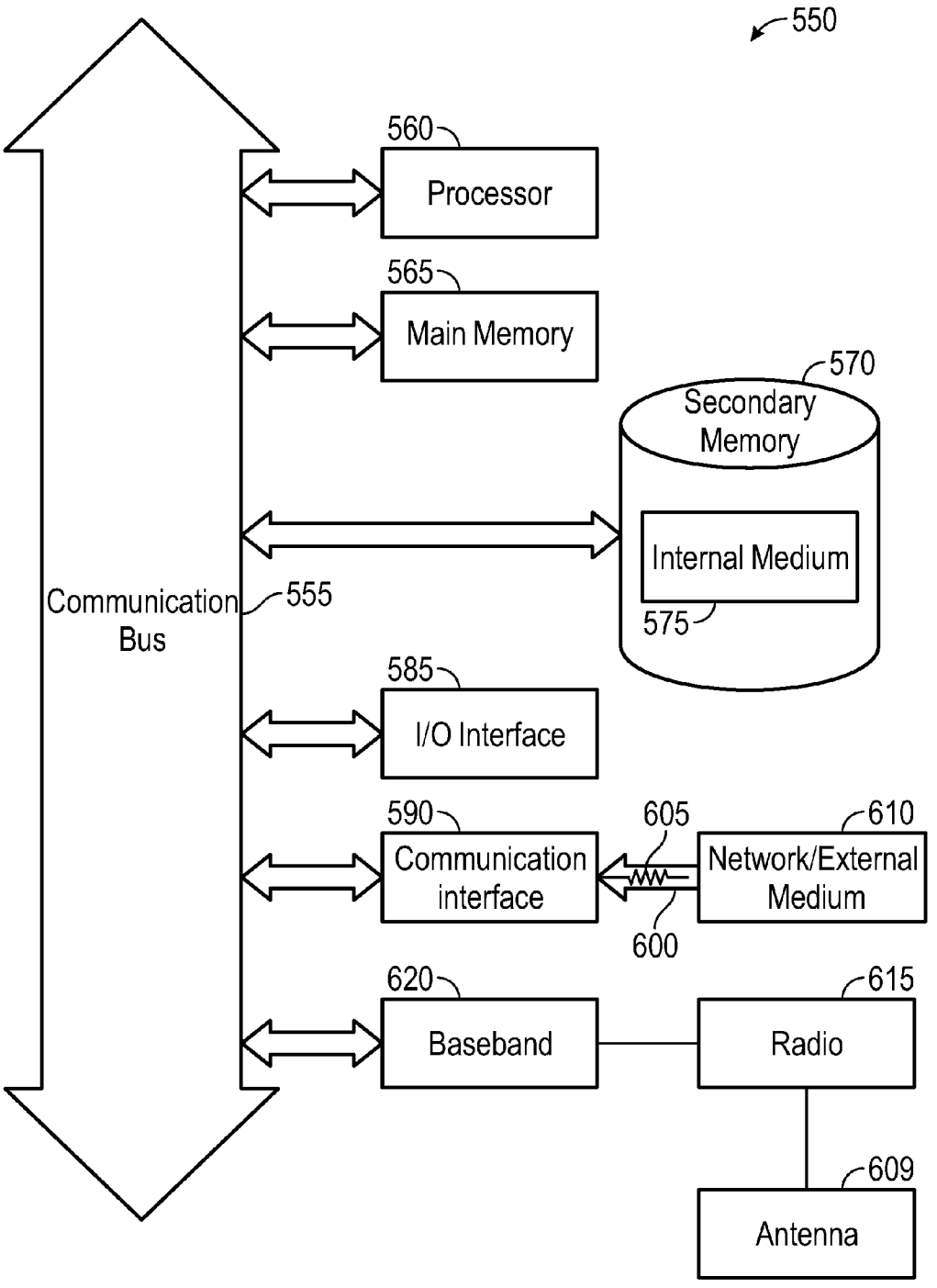
550
560
Processor
565
Main Memory
570
Secondary Memory
Internal Medium
575
Communication Bus
555
585
I/O Interface
590
Communication interface
605
610
Network/External Medium
600
620
Baseband
615
Radio
609
Antenna

FIG. 9

BASKETBALL TRAINING SYSTEM AND METHOD

CROSS-REFERENCE TO RELATED APPLICATIONS

[0001] This application claims the benefit of U.S. Provisional Application No. 62/100,801 filed on Jan. 7, 2015, which is hereby incorporated by reference.

BACKGROUND

[0002] 1. Related Field

[0003] The subject matter discussed herein relates generally to ball sports training systems and methods, and is particularly concerned with a basketball training system and method.

[0004] 2. Related Background

[0005] Basketball players typically practice shooting for extended periods of time at various distances from the basketball hoop and positions relative to the hoop. Typically, a trainer or coach watches the player and manually keeps track of each shot made and missed as well the position of the player for each shot in order to determine shot percentages and identify a player's shooting strength and weaknesses. Since this is very time consuming, coaches are often not able to spend sufficient time watching each player's shooting practice and gathering shooting data to accurately analyze a player's weak areas and provide training in those areas. Video of games can be gathered and stored for later viewing and analysis, using video analysis systems such as those provided by HUDL of Des Moines, Iowa, but this provides only an overview of team performance and not detailed player performance data.

SUMMARY

[0006] According to one aspect, a basketball or other ball sport training system is provided in which a player's shot performance data is collected automatically during training workouts and provided for review by the player and coach. In one aspect, the system comprises one or more mobile wireless communication devices such as Bluetooth watches or the like for wearing or carrying by a player during training, and a basketball hoop or a goal device with associated sensors and a video camera which collect and transmit information to one or more processors which may be located in the wireless communication device or in a separate computer or website.

[0007] In the case of a basketball training system, a basketball hoop device has a backboard and basketball hoop which may be wall mounted or part of a portable basketball hoop device on a mobile stand. The video camera is mounted on or behind the backboard for collecting video of basketball games and training and transmitting the collected video to the mobile device for storage. A plurality of motion sensors mounted around the backboard are in wireless communication with the mobile communication device or devices for detecting player position relative to the motion sensors and shot attempts, and providing shot attempt and player location information to the one or more processors in the mobile device or elsewhere. In one embodiment, a proximity sensor system is provided for detecting distance of the mobile device from the backboard and position relative to the backboard for each shot. A button on the mobile device is pressed by a player when a shot goes through the hoop. An application or program associated with the one or more processors accumulates distance and shot data and calculates score percentages at different distances from the backboard. At the end of a workout, a display may be provided which indicates shot attempt positions and score percentages at different positions in different colors for different score percentage ranges.

[0008] In one aspect, the portable or wearable wireless communication device is a Bluetooth device. The one or more processors collect and store shot data with position for each shot and scoring shot information of a player wearing or carrying the device during training, as well as video data of the training session downloaded from the camera. Data accumulated during a training session may be processed by an app or program provided in a microprocessor or controller of the portable device itself or a separate computer or processor to calculate shooting percentages at different player positions and distances from the hoop. Player training reports and associated videos may be transmitted to a website for easy access by players, trainers, recruiters and the like. The portable or wearable device or a computer communicating with the device is configured to display video footage of the training session as well as calculated shooting percentages, eliminating the need to have a second person watching all shots and manually entering distance and hit or miss data for each shot and calculating shooting percentages from such data.

[0009] In one aspect, a portable basketball hoop device with an integrated video camera and sensors is provided. Alternatively, these components may be provided in a retrofit kit for replacing the backboard of an existing fixed or portable basketball hoop, or as separate components for mounting on an existing backboard, along with two or more portable or wearable wireless communication devices. In one aspect, a portable basketball hoop device comprises a base, a pole extending vertically from the base, a backboard adjustably mounted on the pole for adjusting hoop height, and a hoop secured to the backboard at a position spaced in front of the backboard. Motion sensors which detect shot attempts are mounted at spaced intervals on the backboard for providing outputs to the portable device on detection of shot attempts. A proximity sensor system associated with the backboard and mobile communication device detects distance and position of the player wearing or carrying the device, and stores this data each time a shot is detected. The video camera is associated with the basketball hoop device and positioned to face the play area and shoot a video of a player's workout which is communicated to the portable device for storage and later playback.

[0010] In one aspect, an electronic scoreboard provided on the backboard also displays the number of shots made based on player pressing of the score button or key on the mobile device for each shot that goes in. Alternatively, shots going through the hoop may be detected by appropriate sensors in or behind the hoop. In one aspect, two electronic score boards may be provided for accumulating shots of two different players each wearing or carrying one of the portable wireless communication devices, for use when playing one on one basketball games, for example.

[0011] In another aspect, the portable basketball hoop is designed for outdoor use and has a built-in solar panel and associated battery for providing power to the video camera, sensors, and scoreboard display panels.

[0012] In another aspect, a portable basketball hoop device is provided in which the height of the hoop can be readily adjusted for players of different heights, such as children of different ages and adults of different height. In one aspect, the

portable basketball hoop device comprises a base stand, a pole extending upwards from the stand, a backboard, a hoop projecting from the backboard, and a mounting assembly which adjustably mounts the backboard on the pole so that the height of the hoop can be adjusted. In one aspect, the mounting assembly includes a drive device which moves the backboard up and down relative to the pole, and a wireless control device which controls actuation and direction of the drive device, whereby the height of the backboard and hoop can be remotely controlled. In one embodiment, a four bar pivot linkage secures the backboard to the pole, and the drive device is pivotally linked to at least one bar of the pivot linkage for adjusting backboard height. The drive device may also be actuated manually.

[0013] The pole and attached backboard may be collapsible by means of a swivel mount or the like for storage purposes when not in use. In one aspect, resistance bands for arm and leg exercises may be secured to the base of the basketball hoop device to allow players to exercise while another player is practicing shots.

[0014] Other features and advantages will become more readily apparent to those of ordinary skill in the art after reviewing the following detailed description and the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

[0015] FIG. **1** is a perspective view of one embodiment of a basketball training or monitoring system;

[0016] FIG. **2** is a front elevation view of the portable basketball hoop device of FIG. **1** with a player about to make a shot and wearing a portable wireless communication device forming part of the system of FIG. **1**;

[0017] FIG. **3** is a side elevation view of the basketball hoop device of FIGS. **1** and **2**;

[0018] FIG. **4** is a top elevation view of the device of FIGS. **1** to **3**;

[0019] FIG. **5** is a front elevation view of an embodiment of a basketball training retrofit kit for installation on an existing portable or fixed basketball hoop device;

[0020] FIG. **6** is a block diagram of one embodiment of the portable wireless communication device of FIG. **1**;

[0021] FIG. **7** is a functional block diagram illustrating one embodiment of the training system incorporated in the portable wireless communication device of FIG. **6**;

[0022] FIG. **8** is a flow diagram illustrating steps in a method of monitoring a training session and providing a shot performance report for players or trainers using the training system of FIGS. **1** to **7**; and

[0023] FIG. **9** is a block diagram illustrating an example processor based system that may be used in connection with various embodiments described herein.

DETAILED DESCRIPTION

[0024] The subject matter described herein is taught by way of example implementations. Various details have been omitted for the sake of clarity and to avoid obscuring the subject matter. The examples shown and described below are directed to a basketball training system and method and a portable basketball hoop device.

[0025] After reading this description it will become apparent to one skilled in the art how to implement the invention in various alternative embodiments and alternative applications. However, although various embodiments of the present invention will be described herein, it is understood that these embodiments are presented by way of example only, and not limitation. As such, this detailed description of various alternative embodiments should not be construed to limit the scope or breadth of the present invention.

[0026] Although the ball sport training system in the embodiments described below is used for basketball training, similar systems may be used for shot training in other sports in which points are scored by directing a ball through a hoop, into a goal, or the like, such as soccer, football, hockey, ice hockey and the like.

[0027] FIGS. **1** to **4**, **6** and **7** illustrate one embodiment of a basketball training system **100**. The system basically comprises a portable or movable basketball hoop device **120** and one or more portable or wearable wireless communication devices **20** which communicate with system components incorporated in the basketball hoop device **120** in order to track and save training performance. In the embodiment of FIGS. **1** to **4**, device **120** is a portable basketball hoop device which can be used indoors or outdoors, but in alternative embodiments a backboard incorporating the backboard components of FIGS. **1** to **4** may be provided for fixed mounting on an inside or outside wall or fixed pole mount, or a retrofit training system **200** is provided for mounting on a fixed or wall mounted backboard **140**, as illustrated in FIG. **5** and described in more detail below. Some retrofit components in the retrofit system **200** are identical to corresponding components in the portable basketball hoop device **120** of FIGS. **1** to **4**, and like reference numbers are used for like parts as appropriate.

[0028] In one embodiment, two or more wireless communication devices **20** are provided in the system, and may be designed to be worn or carried by two players or more players at the same time during training or games. In the illustrated embodiment, devices **20** may be secured to players by arm or wrist bands or straps. In one embodiment, devices **20** are designed as Bluetooth watches including a basketball training app, as described in more detail below, and may be incorporated in simple wrist or arm bands or designed for carrying in other ways in alternative embodiments, such as hung around the neck, in a pocket, or the like. Alternatively, the basketball training app or software may be downloaded onto a player's mobile phone which they carry during training. Devices **20** are configured for wireless communication with other system components via Bluetooth or other wireless communication protocols, and the system distinguishes between inputs from different devices **20** and stores accumulated data separately for each player under that player's profile, as described in more detail below.

[0029] One embodiment of a wireless communication device in the basketball training or monitoring system **100** is described in more detail below in connection with FIGS. **6** to **8**. Device **20** communicates with various components of the system incorporated in basketball hoop device **120**, as described in more detail below. In one embodiment, devices **20** with wrist or arm bands are provided for wearing on the left and right wrist or arm of a player. The device **20** may comprise a smart watch with a touchscreen display, a built-in stop watch function and other functions.

[0030] As best illustrated in FIGS. **1** to **4**, in one embodiment a basketball hoop device **120** comprises a support base **1** which may have one or more hollow compartments designed for filling with sand, water or the like for stability purposes, an upright pole or post **2** extending upward from

base **1**, and a backboard **6** with a surrounding support frame **5** adjustably mounted on pole **2**. A basketball hoop **7** is secured to a lower central position on the backboard and spaced outward from the backboard. The backboard may be of acrylic glass as is known in the field. V-brace **13** extends between a rear portion of the base **1** and a raised position on post **2** and is secured to base **1** and post **2** via suitable connecting hardware **21** to add strength and support. In the illustrated embodiment, a servo motor **11** is mounted on the rear side of post **2** and a drive screw shaft **9** extends upwards from motor **11**. As best illustrated in FIG. **3**, backboard **6** is adjustably mounted on post **2** via a four bar pivot linkage **35** comprising upper pivot link or pair of parallel upper links or pivot arms **3** pivotally mounted at one end to the rear of backboard **6** or backboard frame **5** and at the other end to an upper part of post **2**, and lower pivot arm or arms **4** pivotally mounted at one end to backboard **6** or frame **5** at a location spaced below the pivot connection of upper pivot arms **3**, pivoted to post **2** at an intermediate position **36**, and connected at the opposite or rear end to ball screw end mount **8** of screw shaft **9**. This allows the height of the backboard and hoop to be readily adjusted without changing their orientation. End mount **8** is driven up and down screw shaft **9** by actuation of drive motor or servo motor **11**. In one embodiment, servo motor **11** includes a control input (FIG. **7**) and a position encoder **15** and is adapted to be actuated remotely by a user via a user control input **128** (see FIG. **6**) of portable device **20** worn or carried by the user, as described in more detail below, or other wireless controller. Thus, the height of the hoop **7** can be easily adjusted by a player or coach to accommodate players of different heights, such as children and adults. Alternatively, hoop height can be adjusted by a suitable manual input device provided on the post or the drive motor housing. In other embodiments, the portable basketball device may also be used as a stand-alone, height adjustable basketball hoop device without the training system and associated components.

[0031] As illustrated in FIG. **1**, a plurality of Bluetooth enabled motion sensors **25** are provided on the backboard and configured for communication with portable communication device **20** as described in more detail below. In the illustrated embodiment, sensors **25** are provided at spaced positions around the periphery of backboard **6**, and monitor player or portable communication device position relative to the board (distance and angle) along with shot detection outputs on detection of ball motion in the vicinity of the backboard indicating that a player has made a shot. FIG. **2** illustrates sensor detection of player or portable communication device position relative to the indicated sensors **25** at the time a shot is made. On detection of the shot attempt, sensors also provide output on the player position and distance from the hoop at the time of the shot. Sensors may be provided elsewhere on the backboard and a greater or a lesser number of sensors may be provided in alternative embodiments, depending on the number of sensors needed to detect shots coming from different positions relative to hoop **7**.

[0032] Backboard **6** in one embodiment also includes electronic score boards **17**, **18** at opposite upper corners for accumulating scores of one or more players during a training session or one-on-one game. Only one score board may be provided in some embodiments. Score boards **17**, **18** may be incorporated into a display embedded in backboard **6** or may be separate devices hung from the backboard via hooks **28**. A shot clock **19** may also be provided above the center of the board, as illustrated in FIG. **4**. Shot clock **19** may be mounted on the upper rim of the board via mounting bracket **24**. In one example, the score boards **17**, **18** are different colors and are incremented each time a respective player presses a shot key or button of user control input **128** of FIGS. **6** and **7**, as described in more detail below. Each score board **17**, **18** is associated with a respective communication device or Bluetooth watch **20** and is actuated to increment the score on receipt of a score input from the respective device **20**. Alternatively, one or more sensors around the hoop may detect a ball passing through the hoop and provide a score output to the wireless communication device or other computer to increment the saved score as well as the score on the scoreboard.

[0033] A video camera **27** may be mounted behind the backboard as illustrated in FIG. **3** or on the backboard in alternative embodiments. The video camera may also be controlled from the portable communication device **20** and video output may be linked to a video input of device **20** and stored by the device, as described below. As illustrated in FIG. **2**, camera **27** is directed through a window **38** above hoop **7** and is designed to record players as they direct shots towards hoop **7**. The camera may be directed at the player via inputs from the various position sensors **25**. The video data can later be compared to the accumulated shot data for each player, including shots made and missed and corresponding shooting positions, so that weak positions for a player's shots can be identified for future training sessions.

[0034] Optional resistance training bands **14** may be secured to base **1** for arm and leg strength training by players while another player is practicing shots. In another aspect, the portable basketball hoop is designed for outdoor use and has a built-in solar panel **12** as illustrated in FIG. **3**, and has an associated battery (not visible in the drawings) for providing power to the video camera, sensors, servo motor **11**, and scoreboard shot clock **19** and score display panels **17**, **18**. Solar panel may be mounted on top of pole **2** in one embodiment, as illustrated in FIG. **3**. In one embodiment, base **1** has front wheels **40** and a handle **42** at the rear for lifting the back of base **1** and transporting the portable basketball hoop device **120** from one location to another. In one embodiment, pole **2** may be pivotally mounted on base **1** and V-struts **13** may be collapsible to allow the pole and baseboard to be folded down into a generally flat, more compact storage position when not in use.

[0035] FIG. **5** illustrates components of a retrofit basketball training kit for installing on an interior or exterior wall or fixed pole. In one embodiment, the retrofit kit comprises a backboard **6** and the same system components illustrated in FIG. **1** mounted on the backboard **6**, along with the portable communication devices **20**. In an alternative embodiment, the kit comprises separate components of the system adapted to be installed on an existing basketball hoop backboard **70** such as a fixed wall mounted or pole mounted backboard and hoop, and FIG. **5** illustrates the components of this embodiment mounted on backboard **70**. Apart from the different mounting arrangements, the components are identical to those of the previous embodiment and like reference numbers are used for like parts as appropriate. The components comprise one or two electronic score boards **17**, **18** which have mounting hooks **28** for hanging on the upper edge of the backboard, a shot clock or 24 second clock **19** with mounting base **24** with mounting screws for securing to the top center of the backboard, a plurality of wireless, Bluetooth enabled motion and

position sensors **25** for attaching at spaced locations around the periphery of the backboard using adhesive, screws or the like, and a video camera **27** for mounting on the center of the backboard when wall mounted.

[0036] FIG. **6** is a simplified block diagram of one embodiment of portable wireless communication device **20** which includes a central processing unit or microprocessor **130** in communication with power supply **122**, data storage unit or module **124**, a short range wireless antenna or transceiver **125** such as a Bluetooth antenna, one or more second communication modules **126** for Internet, cellular, or other communications via wireless or wired communication protocols, a user input device **128** such as a keypad, touchscreen, or other input mechanism, and a display unit **131**. The display unit may include a watch face with a timer and/or stopwatch function (not illustrated). The power supply **122** may be a battery or the like and provides power to the microprocessor and other components, and may be contained in the same housing as microprocessor **20**, for example. The battery may be re-chargeable with a conventional cell-phone type charger. The device **20** may be a communication device such as a cell phone with a basketball training monitor app downloaded by a user onto the device, or may be a custom made portable wireless communication device on a wristband or the like for wearing by players during basketball training workouts.

[0037] FIG. **7** is a more detailed drawing illustrating various devices and functional modules of the training app or program which may be provided on portable wireless devices **20**. As illustrated, microprocessor **20** includes a transceiver or communication module **132** which receives inputs from various sensors and other monitoring devices associated with the basketball training hoop device **120** and also provides outputs to one or more of the monitoring devices via antenna **125**. Any suitable short distance wireless communication link may be used, such as Bluetooth, WLAN, WI-FI, or the like. In one embodiment, antenna **125** is a Bluetooth antenna, and transceiver module **132** is a Bluetooth HID (human interface device) module such as a BCM20730 module, manufactured by Broadcom Corporation of Irvine, Calif. Communication module **132** may also be configured for long distance wireless communication with other remote devices **60** such as computers, cell phones or the like via a second wireless antenna **126** or via a USB plug in to a local computer or laptop. Also included in microprocessor **20** in one embodiment are a video input module **134** for receiving input from camera **27** and providing control signals to camera **27**, a player shot position sensor module **135**, data storage module **124**, a display control module **137** which controls display unit or LCD **131**, optional hoop height control or adjustment module **138**, and a score count input/output module **139** which all communicate with Bluetooth antenna **125** via remote communications module **132**. Modules **136** and **138** also communicate with the user control input or module **128**. Processor **20** also includes a player shot percentage and position processing module **140** which computes player positions and shot percentages for each position based on sensor inputs from components of the basketball hoop device **120** and input from user control input **128**, as described in more detail below. The user can send a signal to raise or lower the hoop via the hoop height adjustment control module of microprocessor **20**, and the signal is transmitted via Bluetooth antenna **25** to a servo motor controller **64** (see FIG. **3**). A proximity sensor **142** may be provided for detecting distance of a player holding or wearing device **20** from backboard **6**.

[0038] FIG. **8** is a flow diagram illustrating one embodiment of a system and method for monitoring a player's performance during a basketball training session. Initially, the device **20** is configured to obtain and store the player's profile (step **170**). This may be done once on initial use of device **20** by a particular player. In a team coaching situation, other players set up their profiles on their own user devices **20**. In one example, the profile includes some or all of the following information:
Player name

Date of Birth

Height

Weight

[0039] Right or left handed
State and City of residence
School name or club team name
Player's cone drill time

Grade

[0040] Any colleges or teams interested in player.

[0041] Once the user device **20** has been set up for use by a player and either the device is turned on or the training app associated with the device is turned on, the system monitors for start of the workout (step **172**), which may be indicated by player input of a start key on user control input **128**. Once it is determined that a workout has started, the video camera is turned on (step **174**) and all video received by device **20** during the session may be stored or transmitted to data storage unit or module **124** (step **175**). The video camera is turned off when a player actuates an end session input at user control **128** at the end of a training workout. The system monitors for any shot attempts or score inputs during a training session (step **176**). Shot attempts are detected based on sensor outputs from backboard motion sensors **25** received by player shot sensor input module **135** via Bluetooth antenna **125**. On detection of a shot attempt (step **178**), outputs from proximity sensor **142** also received by shot sensor input module **135** enable the player's distance from the backboard to be determined at each shot, and the shot and position information is stored in data storage module **124** along with the time of the shot in step **180**, for later use by player shot percentage and position processing module **140**. If the training session is over (**182**), the routine ends (**184**), otherwise the system continues to monitor for detection of more shots (**178**). If the player scores on any shot, they manually enter a score on input device or control input **128** which is detected at step **185**, and the electronic scoreboard **17** or **18** associated with that user device is incremented by one (step **186**). The score and the time the score input was detected is stored in the data storage unit (step **188**), and the detected player position may also be stored or determined letter based on comparison with stored shot data, video data, or both. If the training session is over (**190**), monitoring for score entry ends at step **184**. Otherwise, the system continues to monitor for score inputs.

[0042] Prior to a training session, the player or coach may adjust hoop height based on the player's height, either remotely by actuating the hoop height adjustment control module **138** via input at user control device **128**, or by manual adjustment at drive motor **11**. This allows the basketball device **120** to be readily adjusted for training of both adults and children.

[0043] At the end of a training session, the player shot percentage and position processing module **140** calculates player positions, number of shots associated with that position, and the number of score inputs detected while in that position, so that score percentages in each position can be determined. Player position for each shot may be determined from a combination of detected player distance from the backboard at the time of receiving motion sensor inputs, sequence of motion sensor inputs, and/or video data at the time each motion sensor input is received. Player position at each score input when a shot goes through a hoop can be determined based on motion sensor and/or video data received at the same time the player actuates the score input on user input device **128**, which may be a SCORE button or the like. Thus, the processing module **140** can determine the total number of shots at each position and the number of score inputs received at that position. In one embodiment, the direction from which a shot originated may be determined based on tracking ball motion by determining a sequence of outputs from sensors **25**, allowing player position when a shot is taken to be calculated.

[0044] Data on shots taken, distance and location of the player relative to the hoop when each shot is taken, and total scores compared to total shots at that location are accumulated in the data storage unit **124** of the device **20**. A player can record when a shot goes through the hoop **7** by pressing a shot input key or button on the user control input **128**, and this is received by the score count input/output module and recorded by the data storage unit along with location and distance of the player from the hoop at the time of each shot. Thus, data on shots taken as well as which shots went through the hoop and which shots were missed during a training session is stored in the data base along with data on player position for each shot. The accumulated training data may be displayed in various formats on the display unit **130**, and may be transmitted to a remote user device or Internet accessible website **60** where it can be viewed along with the associated training video by coaches, interested colleges or teams, and the player. In one embodiment, the playing area around the hoop is displayed with score percentages from each position displayed in different dot sizes and colors to indicate where the player scores well and where they need further training. Such information can be accumulated over time to determine player performance improvement.

[0045] The system described above may be used by multiple players and coaches at the same time, and accumulates data on each player in the stored profile for that player. Output reports from the training system described above can be provided for review by players and trainers or coaches to determine weak and strong shooting positions, and determine what shot positions require further training. At the same time, accumulated video of the training session can be reviewed so that mistakes can be seen. Accumulated video and shot percentage results may be transmitted to a training website, and the player and trainer can log in to see how they did in a workout, by viewing video footage of shots side-by-side with the calculated shooting percentages. Data can also be viewed on the watch or portable device **20**. In one embodiment, each player is logged in at the website with a time stamp to their account each time they initiate a training session, and the system keeps track of how many times a day, week or month each player trains. Level of shot performance over time can be accumulated and provided in a graphical chart or bar chart for each player, showing growth as a shooter. The website may be configured to store game videos and individual player performance highlights to each player account and allow players to download game highlights, High School performance highlights, and the like. The website or mobile app in one embodiment has a player setting visible only to the player and a coach setting that only the coach can see.

[0046] In some embodiments, the system may also have a setting for college coaches and recruiters to receive shot percentage data or view game video or data, and to monitor growth and performance of promising players on a nationwide basis. Coaches can download high school or club basketball statistics. The system may be configured to nationally rank all players using the system by grade and graduation class so they can see what each player around the world is doing. Ranking continuously adjusts as players take more shots over time.

[0047] Although the system described above is designed for basketball training and coaching, similar systems may be used in other sports where scoring by aiming a ball into a hoop, goal, net or the like is involved, such as soccer, hockey, ice hockey and the like.

[0048] The foregoing systems and methods and associated devices and modules are susceptible to many variations. Additionally, for clarity and conciseness, many descriptions of the systems and methods have been simplified.

[0049] FIG. **9** is a block diagram illustrating an example of a computer system **550** that may be used in connection with various embodiments described herein. For example, the computer system **550** may be used as the microprocessor or central processing unit which receives the outputs of the sensor devices used to detect motion and distance of a player from a hoop and of the video camera, and controls processing and storage of training data as well as transmission of accumulated data via a transceiver or antenna. However, other computer systems and/or architectures may be used, as will be clear to those skilled in the art.

[0050] The computer system **550** preferably includes one or more processors, such as processor **560**. Additional processors may be provided, such as an auxiliary processor to manage input/output, an auxiliary processor to perform floating point mathematical operations, a special-purpose microprocessor having an architecture suitable for fast execution of signal processing algorithms (e.g., digital signal processor), a slave processor subordinate to the main processing system (e.g., back-end processor), an additional microprocessor or controller for dual or multiple processor systems, or a coprocessor. Such auxiliary processors may be discrete processors or may be integrated with the processor **560**.

[0051] The processor **560** is preferably connected to a communication bus **555**. The communication bus **555** may include a data channel for facilitating information transfer between storage and other peripheral components of the computer system **550**. The communication bus **555** further may provide a set of signals used for communication with the processor **560**, including a data bus, address bus, and control bus (not shown). The communication bus **555** may comprise any standard or non-standard bus architecture such as, for example, bus architectures compliant with industry standard architecture ("ISA"), extended industry standard architecture ("EISA"), Micro Channel Architecture ("MCA"), peripheral component interconnect ("PCI") local bus, or standards promulgated by the Institute of Electrical and Electronics Engineers ("IEEE") including IEEE 488 general-purpose interface bus ("GPIB"), IEEE 696/S-100, and the like.

[0052] Computer system **550** preferably includes a main memory **565** and may also include a secondary memory **570**. The main memory **565** provides storage of instructions and data in a computer readable medium for programs executing on the processor **560**, such as the programs illustrated in the flow diagrams of FIG. **8** and described above, and the cached map of key color and 12-key values, and the corresponding alphanumeric values and controls. The main memory **556** is typically semiconductor-based memory such as dynamic random access memory ("DRAM") and/or static random access memory ("SRAM"). Other semiconductor-based memory types include, for example, synchronous dynamic random access memory ("SDRAM"), Rambus dynamic random access memory ("RDRAM"), ferroelectric random access memory ("FRAM"), and the like, including read only memory ("ROM").

[0053] The secondary memory **570** may optionally include a hard disk drive which has an internal storage medium (hard disk) **575** and/or a removable storage drive for receiving a removable storage medium.

[0054] In alternative embodiments, secondary memory **570** may include other similar means for allowing computer programs or other data or instructions to be loaded into the computer system **550**. Such means may include, for example, an external storage medium and interface **585**. Examples of an external storage medium may include an external hard disk drive or an external optical drive, or an external magneto-optical drive.

[0055] Other examples of secondary memory **570** may include semiconductor-based memory such as programmable read-only memory ("PROM"), erasable programmable read-only memory ("EPROM"), electrically erasable read-only memory ("EEPROM"), or flash memory (block oriented memory similar to EEPROM). Also included are any other removable storage units and interfaces, which allow software and data to be transferred from the removable storage unit to the computer system **550**.

[0056] Computer system **550** may also include a communication interface **590**. The communication interface **590** allows software and data to be transferred between computer system **550** and external devices **610** (e.g. printers, external storage media), networks, or information sources, and devices as described above which are associated with basketball hoop device **120**. For example, computer software or executable code may be transferred to computer system **550** from a network server via communication interface **590**. Examples of communication interface **590** include a modem, a network interface card ("NIC"), a communications port, a PCMCIA slot and card, an infrared interface, and an IEEE 1394 fire-wire, just to name a few. Communication interface may also comprise Bluetooth or other wireless communication interface **125** of FIG. **7**.

[0057] Communication interface **590** preferably implements industry promulgated protocol standards, such as Ethernet IEEE 802 standards, Fiber Channel, digital subscriber line ("DSL"), asynchronous digital subscriber line ("ADSL"), frame relay, asynchronous transfer mode ("ATM"), integrated digital services network ("ISDN"), personal communications services ("PCS"), transmission control protocol/Internet protocol ("TCP/IP"), serial line Internet protocol/point to point protocol ("SLIP/PPP"), and so on, but may also implement customized or non-standard interface protocols as well.

[0058] Software and data transferred via communication interface **590** are generally in the form of electrical communication signals **605**. These signals **605** are preferably provided to communication interface **590** via a communication channel **600**. Communication channel **600** carries signals **605** and can be implemented using a variety of wired or wireless communication means including wire or cable, fiber optics, conventional phone line, cellular phone link, wireless data communication link, radio frequency ("RF") link, or infrared link, just to name a few.

[0059] Computer executable code (i.e., computer programs or software) is stored in the main memory **565** and/or the secondary memory **570**. Computer programs can also be received via communication interface **590** and stored in the main memory **565** and/or the secondary memory **570**. Such computer programs, when executed, enable the computer system **550** to perform the various functions of the embodiments described above.

[0060] In this description, the term "computer readable medium" is used to refer to any non-transitory computer readable storage media used to provide computer executable code (e.g., software and computer programs) to the computer system **550**. Examples of these media include main memory **565**, secondary memory **570** (including hard disk drive), and external storage medium **610**, and any peripheral device communicatively coupled with communication interface **590** (including a network information server or other network device). These non-transitory computer readable mediums are means for providing executable code, programming instructions, and software to the computer system **550**.

[0061] In an embodiment that is implemented using software, the software may be stored on a computer readable medium and loaded into computer system **550** by way of the removable storage drive, interface **585**, or communication interface **590**. In such an embodiment, the software is loaded into the computer system **550** in the form of electrical communication signals **605**. The software, when executed by the processor **560**, preferably causes the processor **560** to perform the features and functions previously described herein.

[0062] Various embodiments may also be implemented primarily in hardware using, for example, components such as application specific integrated circuits ("ASICs"), or field programmable gate arrays ("FPGAs"). Implementation of a hardware state machine capable of performing the functions described herein will also be apparent to those skilled in the relevant art. Various embodiments may also be implemented using a combination of both hardware and software.

[0063] The system **550** also includes optional wireless communication components that facilitate wireless communication over a voice and over a data network. The wireless communication components comprise an antenna system **609**, a radio system **615** and a baseband system **620**. In the communication device **550**, radio frequency ("RF") signals are transmitted and received over the air by the antenna system **609** under the management of the radio system **615**.

[0064] In one embodiment, the antenna system **609** may comprise one or more antennae and one or more multiplexors (not shown) that perform a switching function to provide the antenna system **609** with transmit and receive signal paths. In the receive path, received RF signals can be coupled from a multiplexor to a low noise amplifier (not shown) that amplifies the received RF signal and sends the amplified signal to the radio system **615**.

[0065] In alternative embodiments, the radio system **615** may comprise one or more radios that are configured to communication over various frequencies. In one embodiment, the radio system **615** may combine a demodulator (not shown) and modulator (not shown) in one integrated circuit ("IC"). The demodulator and modulator can also be separate components. In the incoming path, the demodulator strips away the RF carrier signal leaving a baseband receive audio signal, which is sent from the radio system **615** to the baseband system **620**.

[0066] If the received signal contains audio information, then baseband system **620** decodes the signal and converts it to an analog signal. Then the signal is amplified and sent to a speaker. The baseband system **620** also receives analog audio signals from a microphone. These analog audio signals are converted to digital signals and encoded by the baseband system **620**. The baseband system **620** also codes the digital signals for transmission and generates a baseband transmit audio signal that is routed to the modulator portion of the radio system **615**. The modulator mixes the baseband transmit audio signal with an RF carrier signal generating an RF transmit signal that is routed to the antenna system and may pass through a power amplifier (not shown). The power amplifier amplifies the RF transmit signal and routes it to the antenna system **609** where the signal is switched to the antenna port for transmission.

[0067] The baseband system is also communicatively coupled with the processor **560**. The central processing unit **560** has access to data storage areas **565** and **570**. The central processing unit **560** is preferably configured to execute instructions (i.e., computer programs or software) that can be stored in the memory **565** or the secondary memory **570**. Computer programs can also be received from the baseband processor **610** and stored in the data storage area **565** or in secondary memory, or executed upon receipt. Such computer programs, when executed, enable the communication device **550** to perform the various functions of the present invention as previously described. For example, data storage areas **565** may include various software modules (not shown) that perform the various functions of the present invention as previously described.

[0068] Those of skill will appreciate that the various illustrative logical blocks, modules, units, and algorithm steps described in connection with the embodiments disclosed herein can often be implemented as electronic hardware, computer software, or combinations of both. To clearly illustrate this interchangeability of hardware and software, various illustrative components, blocks, modules, and steps have been described above generally in terms of their functionality. Whether such functionality is implemented as hardware or software depends upon the particular constraints imposed on the overall system. Skilled persons can implement the described functionality in varying ways for each particular system, but such implementation decisions should not be interpreted as causing a departure from the scope of the invention. In addition, the grouping of functions within a unit, module, block, or step is for ease of description. Specific functions or steps can be moved from one unit, module, or block without departing from the invention.

[0069] The various illustrative logical blocks, units, steps and modules described in connection with the embodiments disclosed herein can be implemented or performed with a processor, such as a general purpose processor, a multi-core processor, a digital signal processor (DSP), an application specific integrated circuit (ASIC), a field programmable gate array (FPGA) or other programmable logic device, discrete gate or transistor logic, discrete hardware components, or any combination thereof designed to perform the functions described herein. A general-purpose processor can be a microprocessor, but in the alternative, the processor can be any processor, controller, microcontroller, or state machine. A processor can also be implemented as a combination of computing devices, for example, a combination of a DSP and a microprocessor, a plurality of microprocessors, one or more microprocessors in conjunction with a DSP core, or any other such configuration.

[0070] The steps of a method or algorithm and the processes of a block or module described in connection with the embodiments disclosed herein can be embodied directly in hardware, in a software module executed by a processor, or in a combination of the two. A software module can reside in RAM memory, flash memory, ROM memory, EPROM memory, EEPROM memory, registers, hard disk, a removable disk, a CD-ROM, or any other form of storage medium. An exemplary storage medium can be coupled to the processor such that the processor can read information from, and write information to, the storage medium. In the alternative, the storage medium can be integral to the processor. The processor and the storage medium can reside in an ASIC. Additionally, device, blocks, or modules that are described as coupled may be coupled via intermediary device, blocks, or modules. Similarly, a first device may be described a transmitting data to (or receiving from) a second device when there are intermediary devices that couple the first and second device and also when the first device is unaware of the ultimate destination of the data.

[0071] The above description of the disclosed embodiments is provided to enable any person skilled in the art to make or use the invention. Various modifications to these embodiments will be readily apparent to those skilled in the art, and the generic principles described herein can be applied to other embodiments without departing from the spirit or scope of the invention. Thus, it is to be understood that the description and drawings presented herein represent a presently preferred embodiment of the invention and are therefore representative of the subject matter that is broadly contemplated by the present invention. It is further understood that the scope of the present invention fully encompasses other embodiments that may become obvious to those skilled in the art and that the scope of the present invention is accordingly limited by nothing other than the appended claims.

What is claimed is:

1. A basketball training system, comprising:

at least one mobile wireless communication device for wearing or carrying by a player during training, the wireless communication device including an input for player entry of commands and data and a transceiver for transmitting and receiving data;

a basketball hoop device comprising at least a backboard and a hoop projecting from the backboard, and a plurality of position sensors associated with the backboard and configured to detect the location of the mobile wireless communication device relative to the backboard and to produce output signals corresponding to the detected position of the player and distance of the player from the hoop;

a data storage unit; and

one or more processors associated with the data storage unit which receive inputs from the mobile wireless communication device and sensors, detect shots made by a player directed at the hoop during a training session and count each shot which goes through the hoop as a score, determine the location and distance of the player from the hoop at the time of each shot, and store a record of the number of shots, the number of scores, and the location of the player when each shot and score is made in the data storage unit.

2. The system of claim **1**, wherein the mobile wireless communication device includes the data storage unit and the one or more processors.

3. The system of claim **1**, wherein the input of the mobile wireless communication device includes a score count input for user entry of a score when a shot goes through the hoop, and the one or more processors increment a total score count by one each time user entry of a score is received, and store the player location and time of each score.

4. The system of claim **3**, further comprising an electronic scoreboard associated with the backboard, the one or more processors displaying an updated score count on the electronic scoreboard each time a score is detected.

5. The system of claim **1**, wherein the basketball hoop device is portable and comprises a base stand, a pole extending upwards from the stand, and a mounting mechanism which secures the backboard to the pole.

6. The system of claim **5**, wherein the backboard is adjustably mounted on the pole, the mounting mechanism includes a drive device for moving the backboard up and down on the pole, and the mobile communication device includes a wireless control device for actuating and controlling the drive device, whereby the player can remotely control the height of the backboard.

7. The system of claim **5**, further comprising a video camera positioned on the basketball hoop device and associated with the one or more processors to collect video of training sessions and store the training session video in the data storage unit.

8. The system of claim **5**, wherein the portable basketball hoop device is configured for outdoor use, and includes a built-in solar panel and battery for providing power to one or more components of the basketball hoop device.

9. The system of claim **5**, further comprising resistance bands for arm and leg exercises secured to the base stand of the basketball hoop device.

10. The system of claim **1**, wherein the portable wireless communication device has a wristband for securing around the wrist of a player.

11. The system of claim **10**, wherein the portable wireless communication device comprises a Bluetooth watch having a display unit and including one or more processors which collect and store score inputs entered by the player and other basketball training data.

12. The system of claim **11** wherein the display unit includes a clock display and a stop watch function.

13. The system of claim **1**, further comprising additional portable wireless communication devices for wearing by one or more additional players, the one or more processors further collecting and storing shot location, shot count, and score count information for each additional player separately from other collected player information.

14. The system of claim **1**, wherein the one or more processors compute player shot positions and shot percentages for each location based on the stored shot, score and location data for a training session.

15. The system of claim **1**, wherein the one or more processors transmit stored player training data periodically or on command to a basketball training data website.

16. A portable basketball hoop device, comprising:

a base stand;

a pole extending upwards from the stand;

a backboard including a hoop projecting from the backboard;

a mounting assembly adjustably mounting the backboard on the pole;

a drive device associated with the mounting assembly to move the backboard up and down relative to the pole; and

the drive device having a user actuated control input which controls actuation and direction of the drive device, whereby the height of the backboard and hoop can be adjusted.

17. The device of claim **16**, wherein the control input is configured for receiving manual and remote wireless control inputs by a user.

18. The device of claim **16**, further comprising a four bar pivot linkage securing the backboard to the pole, wherein the drive device comprises a drive motor and a drive member driven by the drive motor and pivotally linked to at least one bar of the pivot linkage for adjusting backboard height.

19. The device of claim **18**, further comprising a lockable swivel mount connecting the pole and attached backboard to the base stand, whereby the pole and backboard are pivotable between a vertical, operative position and a generally horizontal, storage orientation adjacent the base stand.

20. The device of claim **16**, further comprising a plurality of resistance bands for arm and leg exercises secured to the base stand.

21. A retrofit basketball training kit for a wall or pole mounted basketball hoop backboard, comprising:

at least one electronic scoreboard and an attachment device for securing the electronic scoreboard to a basketball hoop backboard;

a plurality of motion and position sensors having attachment devices for attachment at selected positions around a hoop on the basketball hoop backboard; and

at least one mobile wireless communication device for wearing or carrying by a player during training, the wireless communication device including an input for user entry of commands and data and a transceiver for transmitting and receiving data, a data storage unit; and one or more processors associated with the data storage unit which receive inputs from the user input and the sensors and transmit outputs to the electronic scoreboard, detect shots made by a player directed at the hoop during a training session, count each shot which goes through the hoop as a score, determine the location and distance of the player from the hoop at the time of each shot, store a record of the number of shots, the number of scores, and the location of the player when each shot is made in the data storage unit, and transmit a control output to the electronic scoreboard to update a total points score each time a score is counted during a training session.

22. A computer-implemented ball game training method that uses one or more hardware processors to:

receive and store positions of a mobile wireless communication device worn or carried by player relative to a scoring hoop or goal during a ball play training session based on inputs from sensor devices associated with the scoring hoop or goal which detect location of the mobile wireless communication device;

detect shots directed at the scoring hoop or goal during the training session and store each shot along with the detected wireless communication device location for each shot;

detect a score when a ball goes through the hoop or into the goal, and store accumulated total scores for each shot location; and

calculate and store a player's percentages of shots scored and missed at each shot location in a training session.

23. The method of claim **22**, wherein the step of detecting a score comprises detecting player input of a score on the mobile wireless communication device.

24. The method of claim **22**, wherein the ball game is basketball.

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