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(19) **United States**(12) **Patent Application Publication** (10) **Pub. No.: US 2006/0178235 A1****Coughlan et al.**(43) **Pub. Date: Aug. 10, 2006**(54) **APPARATUS AND METHOD FOR
DETERMINING PARTICIPANT CONTACT
WITH A SPORTS OBJECT**(22) Filed: **Feb. 5, 2005****Publication Classification**(75) Inventors: **Marc William Joseph Coughlan,**
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(AU)(51) **Int. Cl.**
A63B 69/00 (2006.01)(52) **U.S. Cl. 473/438**(57) **ABSTRACT**

A method and apparatus determine contact by a participant with a sports object by detecting contact of the sports object with the participant via a personal area network of the participant; transmitting in response to the detection player identification information to a central controller; determining that the sports object has left a field of play by the central controller; and alerting in response to the determination a sports official to identify a last participant to contact the sports object via an official system by the central controller.

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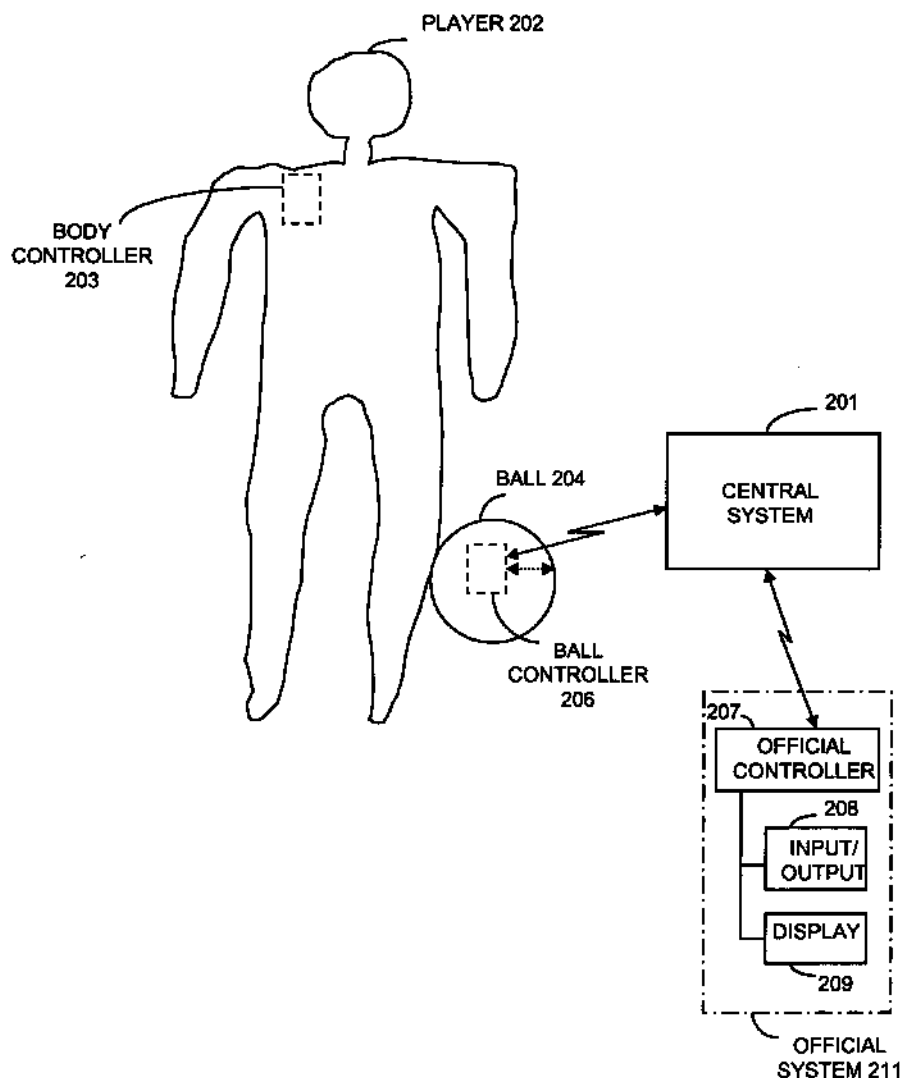
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FIG. 1

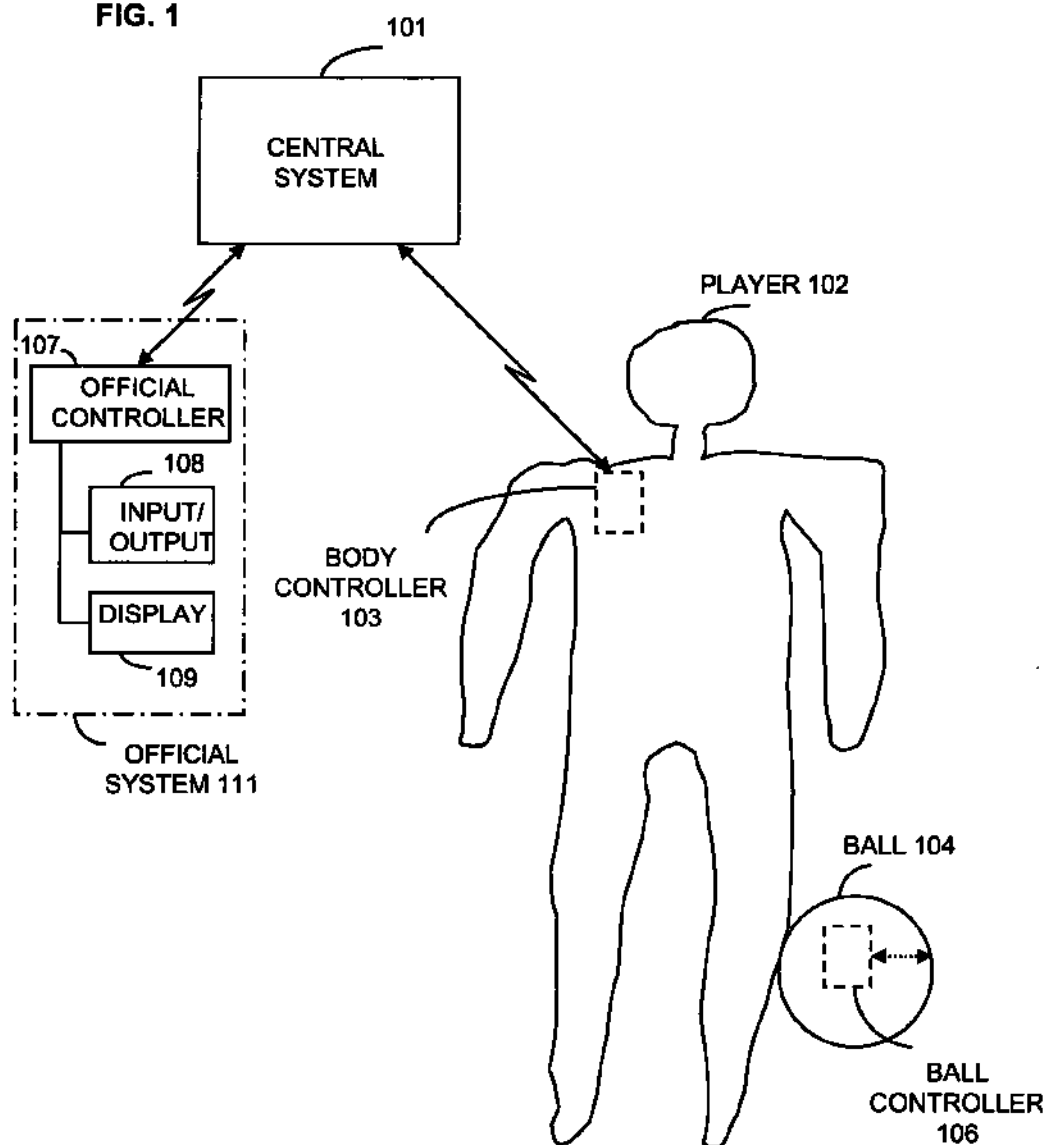


FIG. 2

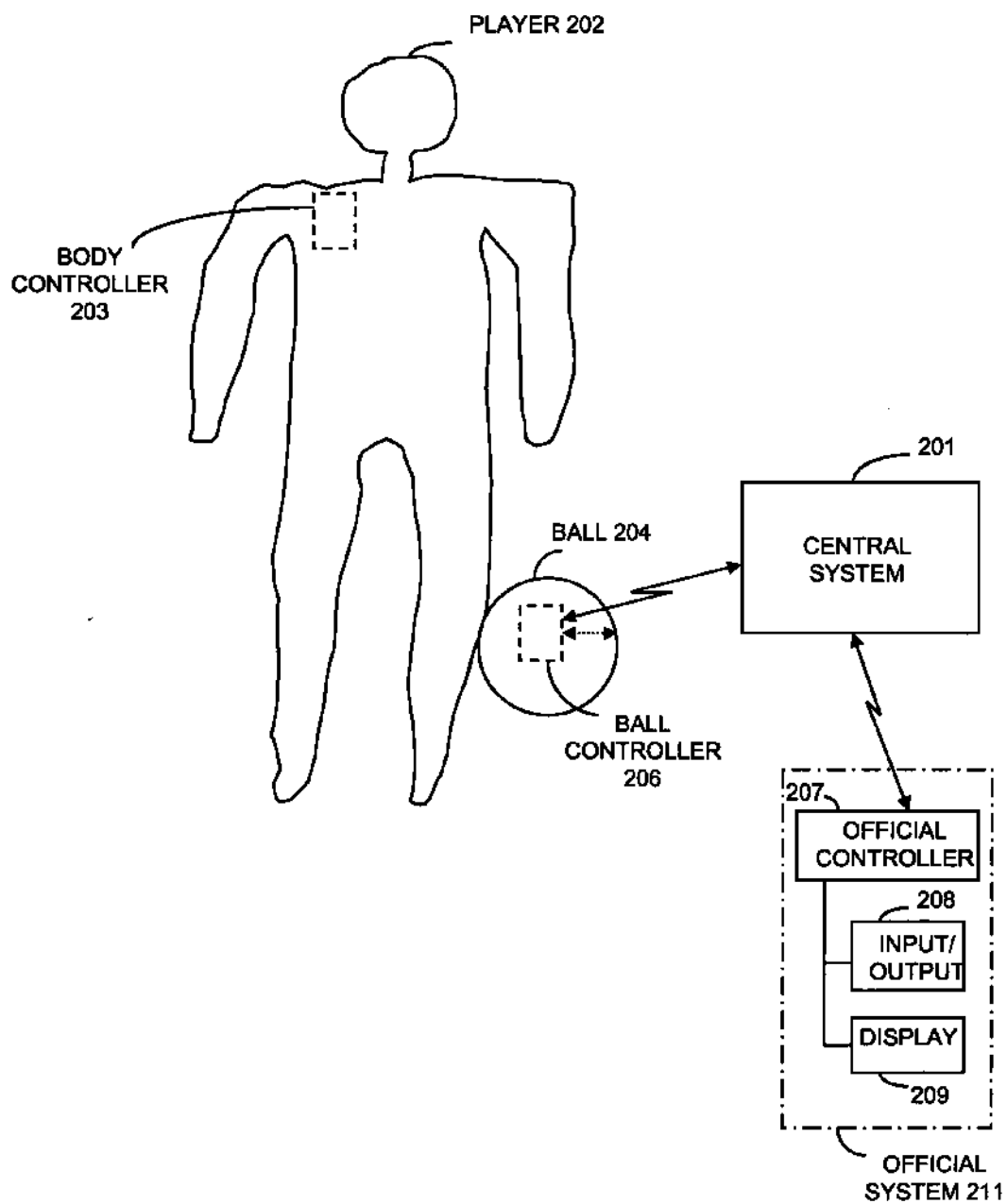


FIG. 3

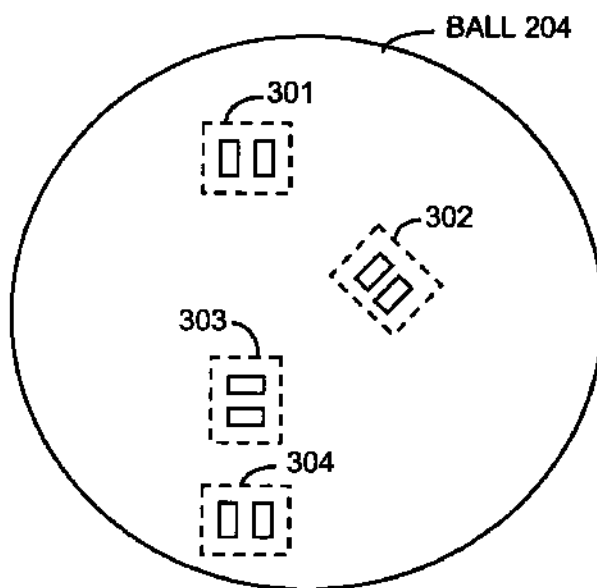


FIG. 4

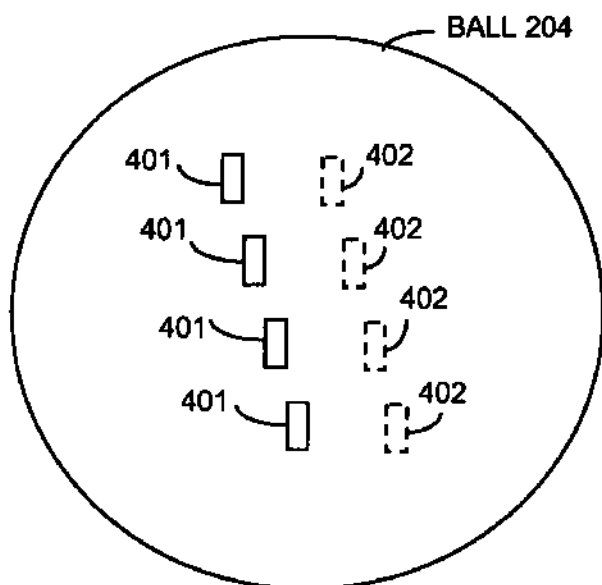


FIG. 5

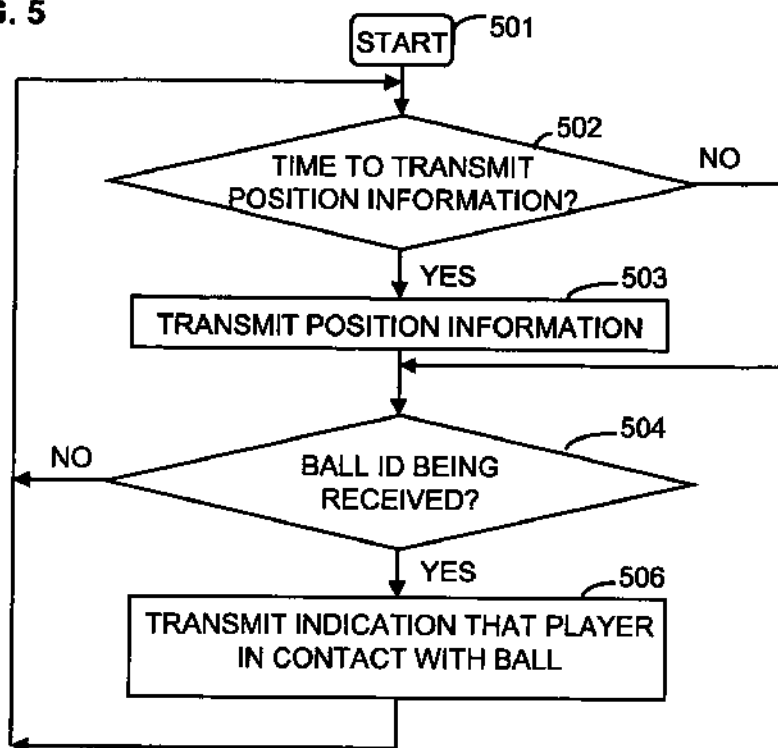


FIG. 7

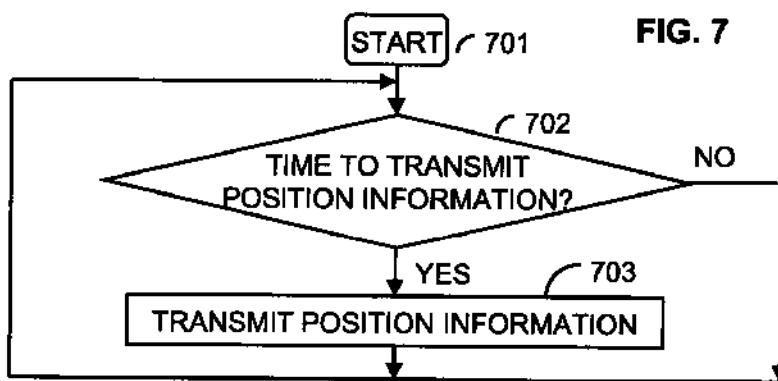


FIG. 8

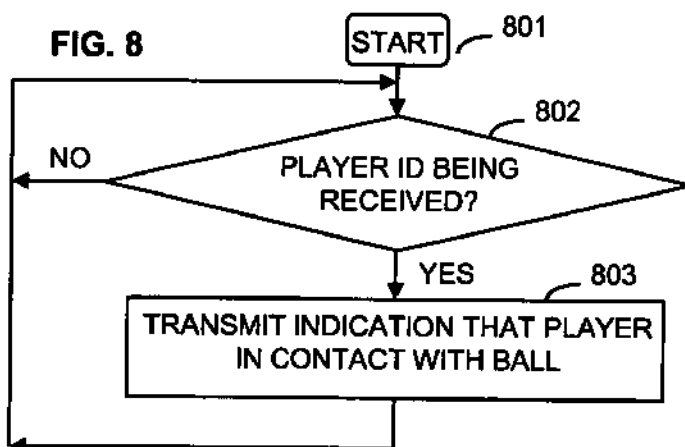
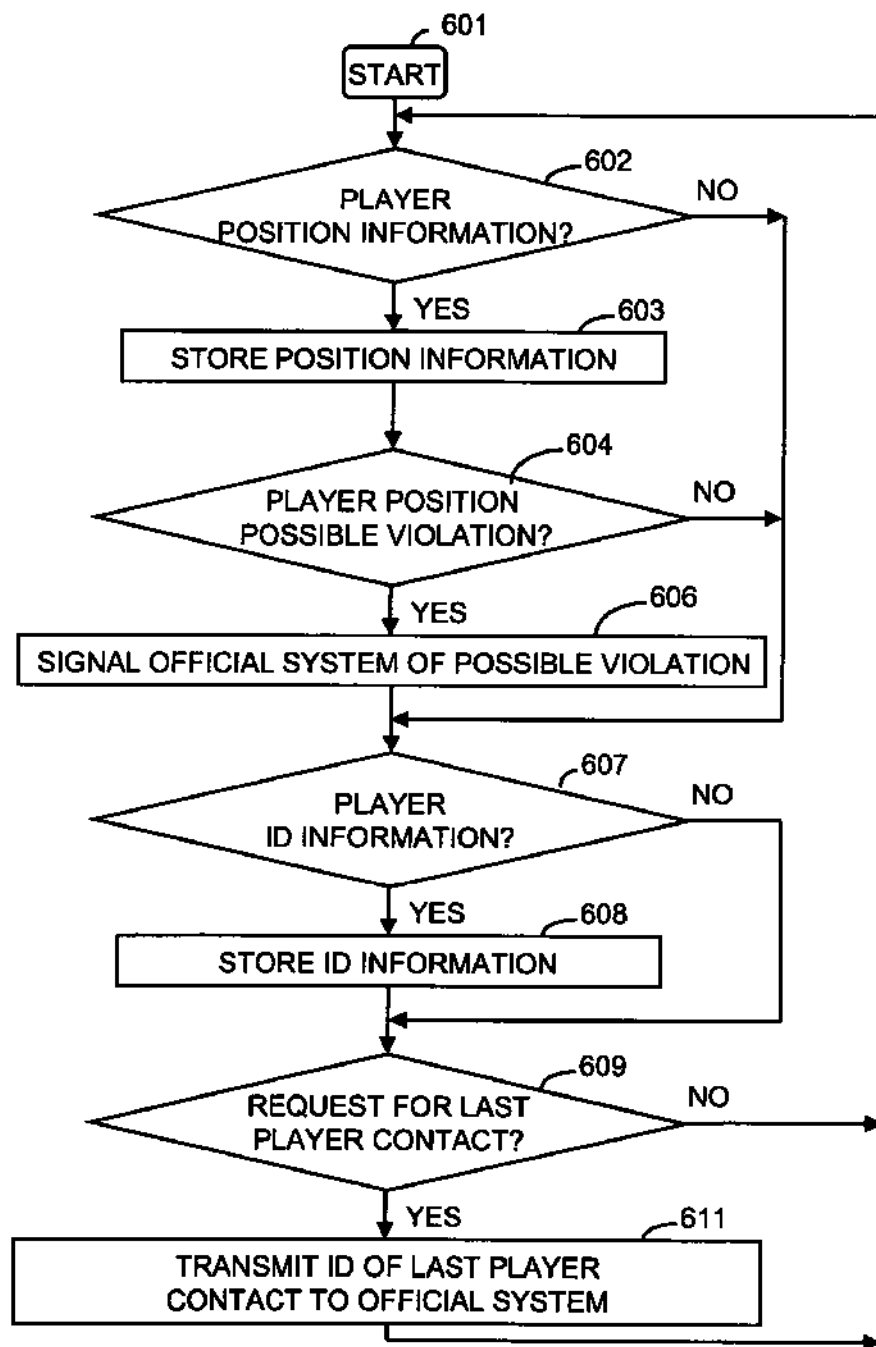


FIG. 6



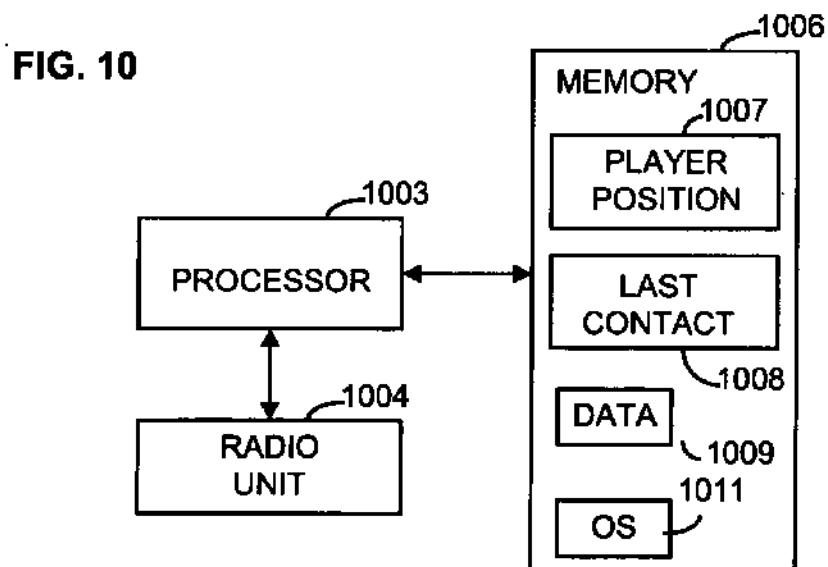
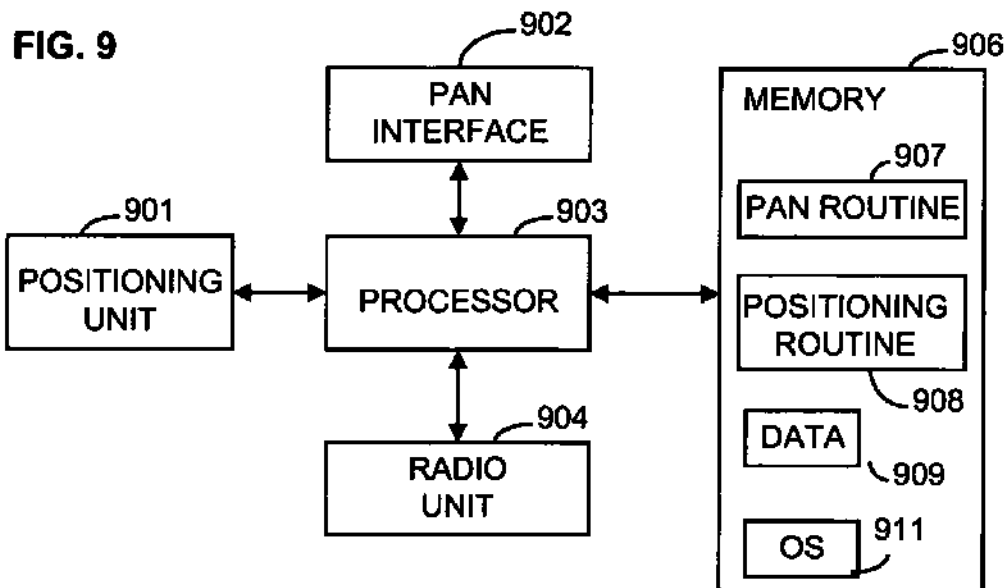


FIG. 11

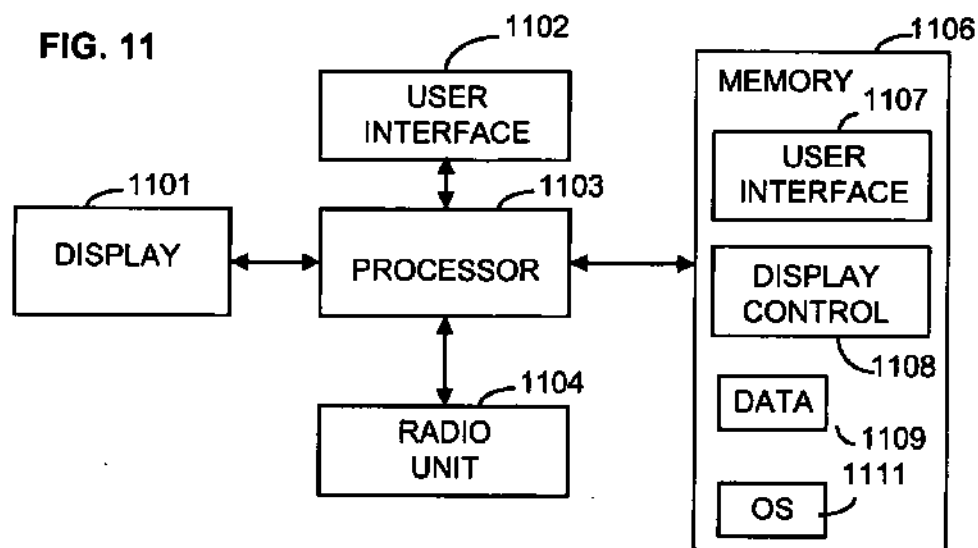
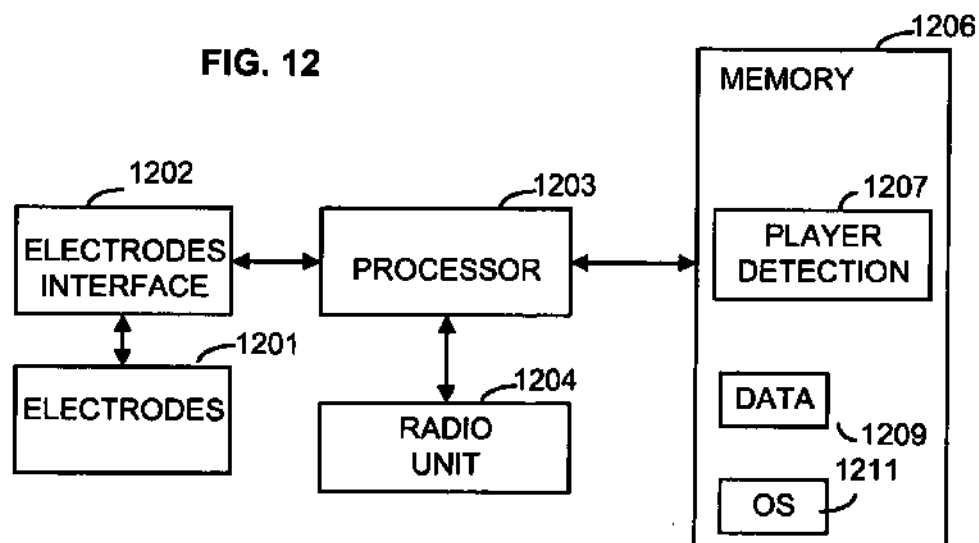


FIG. 12



APPARATUS AND METHOD FOR DETERMINING PARTICIPANT CONTACT WITH A SPORTS OBJECT

TECHNICAL FIELD

[0001] This invention relates to detection of an object being touched by a person.

BACKGROUND

[0002] In many sports, it is important to know which player last touched the game ball. This is particularly true in sports such as basketball and soccer. Whereas, in soccer, it is possible to review a play using instant replay using taped video, it greatly slows down the flow of the game. The problem is not severe in a game such as football which has a natural stopping point at regular intervals. But in soccer particularly, the need to stop the game and review a particular play causes major disruption in the soccer game itself. This is also true in basketball. By the same token, in championship play, a mistake by a referee during a soccer game concerning who was the last player to touch the ball before it went out of bounds can have serious repercussions not only to the game but also to the mood of the crowd which have been known to riot. These considerations are also true for other sports such as rugby, etc.

SUMMARY OF THE INVENTION

[0003] A method and apparatus determine contact by a participant with a sports object by detecting contact of the sports object with the participant via a personal area network of the participant; transmitting in response to the detection participant identification information to a central controller; determining that the sports object has left a field of play by the central controller; and alerting in response to the determination a sports official to identify a last participant to contact the sports object via an official system by the central controller.

BRIEF DESCRIPTION OF THE DRAWINGS

[0004] FIG. 1 illustrates an embodiment of a system;

[0005] FIG. 2 illustrates another embodiment of a system;

[0006] FIG. 3 illustrates an embodiment of connectors positioned on a ball;

[0007] FIG. 4 illustrates another embodiment of the arrangement of conductors on a ball;

[0008] FIG. 5 illustrates, in flowchart form, operations performed by an embodiment of a body controller;

[0009] FIG. 6 illustrates, in flowchart form, operations of an embodiment of a central system;

[0010] FIG. 7 illustrates, in flowchart form, operations of another embodiment of a body controller;

[0011] FIG. 8 illustrates, in flowchart form, operations of an embodiment of a ball controller;

[0012] FIG. 9 illustrates, in block diagram form, an embodiment of a body controller;

[0013] FIG. 10 illustrates, in block diagram form, an embodiment of a central system;

[0014] FIG. 11 illustrates, in block diagram form, an embodiment of an official system; and

[0015] FIG. 12 illustrates, in block diagram form, a ball controller.

DETAILED DESCRIPTION

[0016] In one embodiment, a personal area network (also referred to as a body area network) is created for each player so that the body and the clothing of each player becomes a local area network. The ball or other physical object generates an identification code which is transmitted to the player's personal area network when the ball touches the player's body or clothing. The information is transmitted from the ball to the personal area network via conductors on the surface of the ball. The personal area network of the player is under the control of a body controller which then transmits the information from the ball to a central system. The central system records the players that touch the ball and analyzes this information when it determines that the ball has gone out of the field of play of other game occurrences. This determination may be made based on an input from a game official. At that time, the central controller can transmit to a system utilized by an official of the game (official system), such as a linesman or referee, the information concerning the last player to touch the ball.

[0017] In addition, another embodiment of the body controller allows the body controller to determine the position of the player on the playing field and transmit this information to the central system. Such location information is important, for example, to determine offside decisions in a soccer game.

[0018] In also, another embodiment allows the central system to analysis location and contact information to produce statistical information such as pass completion rates, percentage of ball possession, etc.

[0019] In another embodiment, the body controller of a player transmits the player's identification information to the ball when the player comes in contact with the ball. The ball controller then uses the player identification information to transmit this information to a central system.

[0020] FIG. 1 illustrates an embodiment of a system. Ball controller 106 is continuously transmitting the ball's identification information to the outer surface of the ball. When ball 104 comes into contact with player 102, the ball's identification information is transferred to the personal area network of the player's body or clothes that is under control of body controller 103. The construction of body controller 103 and its interaction with the personal area network is described in greater detail in U.S. Pat. No. 5,796,827 and U.S. Pat. No. 6,104,913, these patents are hereby incorporated by reference. In addition, the incorporated patents disclose the transfer of information from an external object, such as ball 104, to the personal area network.

[0021] Body controller 103 then transmits the fact that ball 104 has touched player 102 to central system 101. Central system 101 analyzes this information and determines if it should be transmitted to official system 111. The transmission of information from central system 101 is to official controller 107. Official controller 107 may choose to provide this information to a game official via input-output device 108 or display device 109. In one embodiment, the identity

of player 102 is always displayed on 109 so that the official can determine the last player to touch the ball before it went out of play. In another embodiment, the official can request this information from central system 101. Input-output device 108 can consist of an audio transducer so that the information from central system 101 can be provided to the official as audio output.

[0022] Body controller 103 also has a location positioning mechanism so as to determine the location of player 102 on the playing field. This location positioning mechanism may utilize global positioning satellite techniques or may utilize gyroscopic positioning techniques as set forth in U.S. Pat. No. 6,792,381 which is hereby incorporated by reference. Body controller 103 transmits the location information to central system 101.

[0023] FIG. 2 illustrates another embodiment of a system. In FIG. 2, body controller 203 is continuously generating the identification information for player 202 and placing this information on the personal area network of player 202. When player 202 comes in contact with ball 204, the identification of player 202 is transferred to ball controller 206 via the conductors on the surface of ball 204 from the personal area network.

[0024] Ball controller 206 then transmits the identification of player 202 to central system 201. Central system 201 after analyzing the information may transfer the information to official system 211 via official controller 207. Official controller 207 can choose to utilize input-output device 208 or display device 209 to inform the official of the last person to touch ball 204.

[0025] FIG. 3 illustrates an embodiment of the exterior of ball 204. The exterior surface of ball 204 comprises a plurality of electrode pairs 301-304 which are utilized by ball controller 206 to receive or transmit information to a player. These pairs of electrodes are arranged on the surface of ball 204 and interconnect to ball controller 206. In one embodiment, ball controller 206 may be a thin film circuit or other miniaturized circuit type on the inner-surface of ball 204. In addition, ball controller 206 may be duplicated for reliability.

[0026] FIG. 4 illustrates another embodiment of the arrangement of conductors along the surface of ball 204. Electrodes 401 are arranged along the exterior surface of the ball. Electrodes 402 are isolated from the surface of the ball but just below the outer skin of the ball. In this embodiment, ball controller 206 may be a thin film circuit or other miniaturized circuit type on the inner-surface of the ball 204. In addition, ball controller 206 may be duplicated for reliability.

[0027] FIG. 5 illustrates, in flowchart form, operations of an embodiment of a body controller such as body controller 103 of FIG. 1. After being started in block 501, decision block 502 determines if it is time to transmit position information defining the location of player 102 on the playing field. If the answer is no, control is transferred to decision block 504. If the answer is yes in decision block 502, block 503 transmits the position information to central system 101 before transferring control to decision block 504. The latter decision block determines if the ball ID is being received because of contact of ball 104 with player 102. If the answer is no in decision block 504, control is

transferred back to decision block 502. If the answer is yes in decision block 504, block 506 transmits the indication of which player is in contact with the ball to central system 101 before transferring control back to decision block 502.

[0028] FIG. 6 illustrates, in flowchart form, operations performed by an embodiment of a central system such as central system 101 or 201. After being started in block 601, decision block 602 determines if player position information has been received. If the answer is no, control is transferred to decision block 607. If the answer is yes, block 603 stores the position information along with the identity of the player. Next, decision block 604 determines, based on the rules of the game, whether there is a possibility that the player's position constitutes a possible violation. If the answer is no, control is transferred to decision block 607. If the answer is yes in decision block 604, block 606 transmits a signal along with the identification of the player to the official system indicating a possible violation before transferring control to decision block 607.

[0029] Decision block 607 determines if player identification information is being received from either a body controller or a ball depending on the particular embodiment. If the answer is no, control is transferred to decision block 609. If the answer is yes in decision block 607, block 608 stores the identification information before transferring control to decision block 609. Decision block 609 determines if there is a request for the last player contact either generated by the central system or being requested by the official via official system such as official system 111 or 211. If the answer is no, control is transferred back to decision block 602. If the answer in decision block 609 is yes, block 611 transmits the identity of the last player to contact the ball to the official system before returning control back to decision block 602.

[0030] FIG. 7 illustrates, in flowchart form, operations performed by a body controller in another embodiment such as body controller 203. Note, that FIG. 7 only illustrates the operations being performed with respect to the central system. Body controller 203 is constantly transmitting the identification of the player via the personal area network in case a ball should come in contact with the player. After being started in block 701, decision block 702 determines if it is time to transmit the position information of the player. If the answer is no, control is transferred back to decision block 702. If the answer is yes, block 703 transmits the position information with the identity of the player to the central system before returning control back to decision block 702.

[0031] FIG. 8 illustrates, in flowchart form, operations performed by an embodiment of a ball controller, such as ball controller 206. The operations illustrated in FIG. 8 are only those performed with respect to central system 201. The ball controller is continuously testing to see if the player identification is being received because the ball has contacted a player. After being started in block 801, decision block 802 determines if a player ID is being received. If the answer is no, decision block 802 is re-executed. If the answer is yes, block 803 transmits the identification of the player and an indication that the player is in contact with the ball before returning control back to decision block 802.

[0032] FIG. 9 illustrates, in block diagram form, a body controller. Processor 903, by executing programs in memory

906, provides the overall control. Positioning unit 901, which may be a global positioning system or a gyroscope system, provides location information to processor 903. Processor 903 transmits and receives data via the personal area network via PAN interface 902. Radio unit 904 provides the reception and transmission of radio signals with the central system.

[0033] PAN routine 907 collects and utilizes information from the PAN. Positioning routine 908 accepts location information from positioning unit 901 and transmits this information to the central system. Data is stored in data 909. Operating system 911 provides the overall control.

[0034] FIG. 10 illustrates, in block diagram form, a central system, such as central system 101 or 201. Processor 1003 provides overall control of the system by execution of routines in memory 1006. Radio unit 1004 provides communications with the body controllers and the ball controller.

[0035] Player position routine 1007 is responsible for receiving player positions and determining whether these positions violate the rules of the game. The last contact routine 1008 provides for the determination of which player last contacted the ball. Data is stored in data 1009. Operating system 1011 provides overall control.

[0036] FIG. 11 illustrates, in block diagram form, an official system such as official system 111 or 211. Processor 1103 receives and transmits information with the central system via radio unit 1104. The user utilizes user interface 1102 to input information into processor 1103, and processor 1103 displays information to the user via display 1101. Processor 1103 performs these activities by the execution of routines and applications in memory 1106.

[0037] User interface routine 1107 provides for receiving and utilizing input from the user from user interface 1102. Display control 1108 not only displays information on display 1101 but also makes the necessary analysis before displaying this information. Data is stored in data 1109. Operating system 1111 provides overall control.

[0038] FIG. 12 illustrates, in block diagram form, an embodiment of a ball controller such as ball controller 106 or 206. Processor 1203 provides overall control by execution of routines in memory 1206. Electrodes interface 1202 provides the interface to electrodes 1201 that are arranged on the ball as illustrated in FIGS. 3 or 4. Radio unit 1204 provides the communication link with the central system. Player detection routine 1207 provides the control for the detection of the player and the transmission of this information to the central system. Data is stored in data 1209, and operating system 1211 provides overall control.

[0039] When the operations of the body controller, ball controller, central system or official system are implemented in software, it should be noted that the software can be stored on any computer-readable medium for use by or in connection with any computer related system or method. In the context of this document, a computer-readable medium is an electronic, magnetic, optical, or other physical device or means that can contain or store a computer program for use by or in connection with a computer related system or method. The software can be embodied in any computer-readable medium for use by or in connection with an instruction execution system, apparatus, or device such as a

computer-based system, processor-containing system, or other system that can fetch the instructions from the instruction execution system, apparatus, or device and execute the instructions. In the context of this document, a "computer-readable medium" can be any means that can store, communicate, propagate, or transport the program for use by or in connection with the instruction execution system, apparatus, or device. For example, the computer-readable medium can be, but is not limited to, an electronic, magnetic, optical, electromagnetic, infrared, or semiconductor system, apparatus, device, or propagation medium. More specific examples (a non-exhaustive list) of the computer-readable medium would include the following: an electrical connection (electronic) having one or more wires, a portable computer diskette (magnetic), a random access memory (RAM) (electronic), a read-only memory (ROM) (electronic), an erasable programmable read-only memory (EPROM, BEPROM, or Flash memory) (electronic), an optical fiber (optical), and a portable compact disc read-only memory (CDROM) (optical). Note that the computer-readable medium could even be paper or another suitable medium upon which the program is printed, as the program can be electronically captured via optical scanning of the paper or other medium and then compiled, interpreted or otherwise processed in a suitable manner, if necessary, and stored in a computer memory.

[0040] In an alternative embodiment, where the body controller, ball controller, central system or official system is implemented in hardware, the body controller, ball controller, central system or official system can be implemented with any or a combination of the following technologies, which are each well known in the art: a discrete logic circuit(s) having logic gates for implementing logic functions upon data signals, an application specific integrated circuit (ASIC) having appropriate combinational logic gates, a programmable gate array(s) (PGA), a field programmable gate array (FPGA), etc.

[0041] Of course, various changes and modifications to the illustrated embodiments described above would be apparent to those skilled in the art. Such changes and modifications can be made without departing from the spirit and scope of the invention and without diminishing its intended advantages. It is therefore intended that such changes and modifications be covered by the following claims except in so far as limited by the prior art.

What is claimed is

1. A method for assisting in officiating a sports contest, comprising the steps of:

- detecting contact of a sports object with a participant via a personal area network of the participant;
- transmitting in response to the detection participant identification information to a central controller;
- determining that the sports object has left a field of play by the central controller; and

- alerting in response to the determination a sports official to identify a last participant to contact the sports object via an official system by the central controller.

2. The method of claim 1 wherein the step of detecting contact of the sports object with a participant comprises the step of receiving information from the personal area network of the participant by a body controller of the participant; and the step of transmitting is executed by the body controller.

3. The method of claim 1 further comprises the steps of determining a location of the participant on the field of play;

transmitting a message to the central controller for determination if the location of the participant is a possible violation of official rules.

4. The method of claim 1 further comprises the steps of determining a location of the participant on the field of play; and

calculating statistical information based on locations of the participant and contacts by the participant with the sports object.

5. The method of claim 1 wherein the step of determining comprises the step of receiving information from the sports official via the official system.

6. The method of claim 1 wherein the step of detecting contact of the sports object with a participant comprises the step of receiving information from the personal area network of the participant by an object controller of the sports object; and

the step of transmitting is executed by the object controller whereby the participant identification information is received from the personal area network.

7. The method of claim 6 further comprises the steps of determining a location of the participant on the field of play;

transmitting a message to the central controller for determination if the location of the participant is a possible violation of official rules.

8. The method of claim 6 further comprises the steps of determining a location of the participant on the field of play; and

calculating statistical information based on locations of the participant and contacts by the participant with the sports object.

9. The method of claim 6 wherein the step of determining comprises the step of receiving information from the sports official via the official system.

10. An apparatus to assist in officiating a sports contest, comprising:

a central controller;

a official system;

a body controller detecting contact with a sports object via a personal area network for a participant and transmitting a contact message to the central controller indicating the contact and participant identification information; and

the central controller transmitting an alerting message to the official system to identify a last participant to contact the sports object upon receipt of the contact message and a determination that the sports object has left a field of play.

11. The apparatus of claim 10 further comprises a participant locator and the body controller transmitting a participant location message based on information from the participant locator to the central controller; and

the central controller determining if the location of the participant is a possible rule violation.

12. The apparatus of claim 10 wherein the central controller further calculating statistical information based on locations of the participant and contacts by the participant with the sports object.

13. An apparatus to assist in officiating a sports contest, comprising:

a central controller;

a official system;

a object controller detecting contact with a sports object via a personal area network for a participant and transmitting a contact message to the central controller indicating the contact and receiving participant identification information from the personal area network; and

the central controller transmitting an alerting message to the official system to identify a last participant to contact the sports object upon receipt of the contact message and a determination that the sports object has left a field of play.

14. The apparatus of claim 13 further comprises a participant locator and a body controller;

the body controller transmitting a participant location message based on information from the participant locator to the central controller; and

the central controller determining if the location of the participant is a possible rule violation.

15. The apparatus of claim 10 wherein the central controller further calculating statistical information based on locations of the participant and contacts by the participant with the sports object.

16. A processor-readable medium for assisting in officiating a sports contest, comprising processor-executable instructions configured for:

processor-executable instructions for detecting contact of a sports object with a participant via a personal area network of the participant;

processor-executable instructions executed by a central controller for transmitting in response to the detection participant identification information;

processor-executable instructions executed by a central controller for determining that the sports object has left a field of play; and

processor-executable instructions executed by a central controller for alerting in response to the determination a sports official and identifying a last participant to contact the sports object via an official system.

17. The processor-readable medium of claim 16 wherein the processor-executable instructions for detecting contact of the sports object with a participant are executed by a body controller of the participant with information from the personal area network of the participant; and

the processor-executable instructions for transmitting are executed by the body controller.

18. The processor-readable medium of claim 16 further comprises the processor-executable instructions for determining a location of the participant on the field of play; and

processor-executable instructions for transmitting a message to the central controller for determination if the location of the participant is a possible violation of official rules.

19. The processor-readable medium of claim 16 further comprises processor-executable instructions for determining a location of the participant on the field of play; and

processor-executable instructions for calculating statistical information based on locations of the participant and contacts by the participant with the sports object.

20. An apparatus for implementing the steps of claim 1.

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