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(54) **ACTIVE SPORTS TRACKER AND METHOD**

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(57) **ABSTRACT**

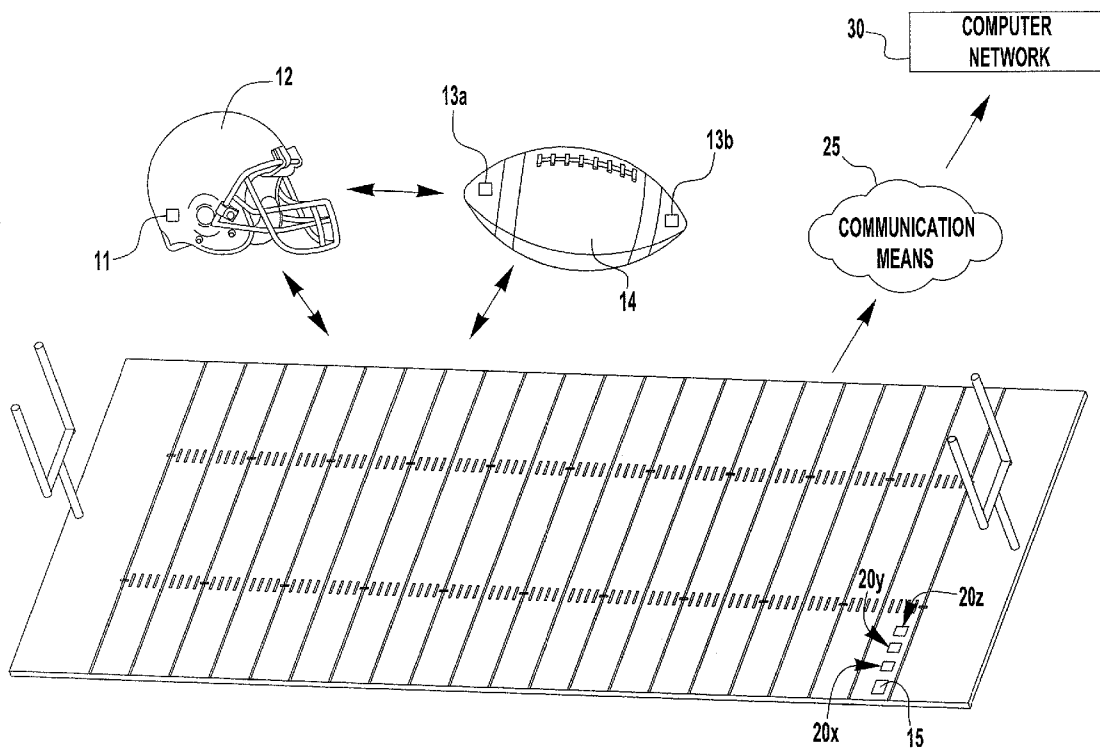
A sports tracking and analysis system includes a RFID tag implanted onto an item associated with a player and at least one RFID tag implanted on a game ball. The tags and reader are arranged to transfer data such as the time and location of player and ball to each other for readers positioned throughout the field. The readers communicate the data to a computer system designed to process the data and generate player performance statistics including real-time measurements of many characteristics and, over time or based on input data, historical performance statistics. A method of tracking and analyzing the performance of a sports game is also included.

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Related U.S. Application Data

(60) Provisional application No. 60/749,499, filed on Dec. 12, 2005.



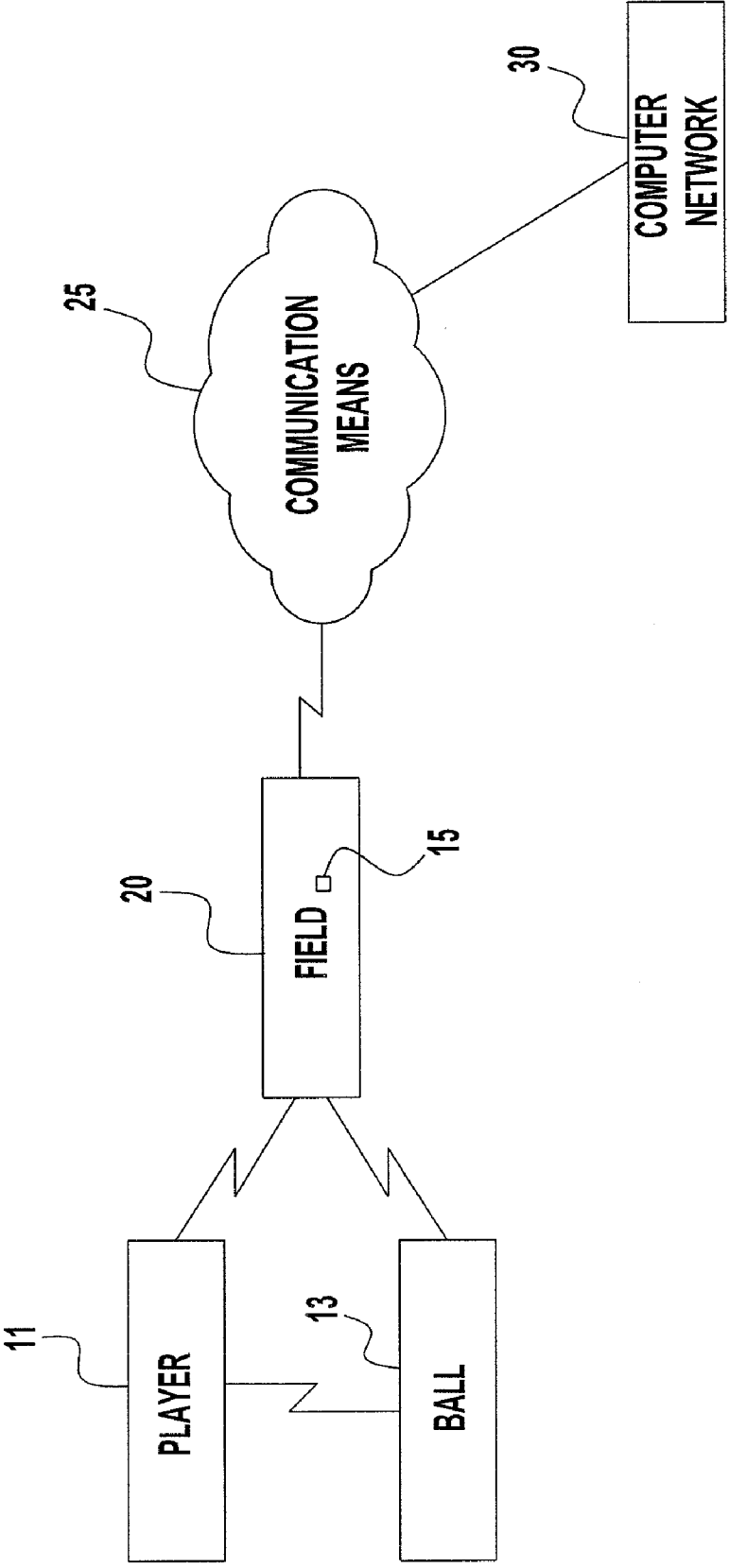


FIG. 1

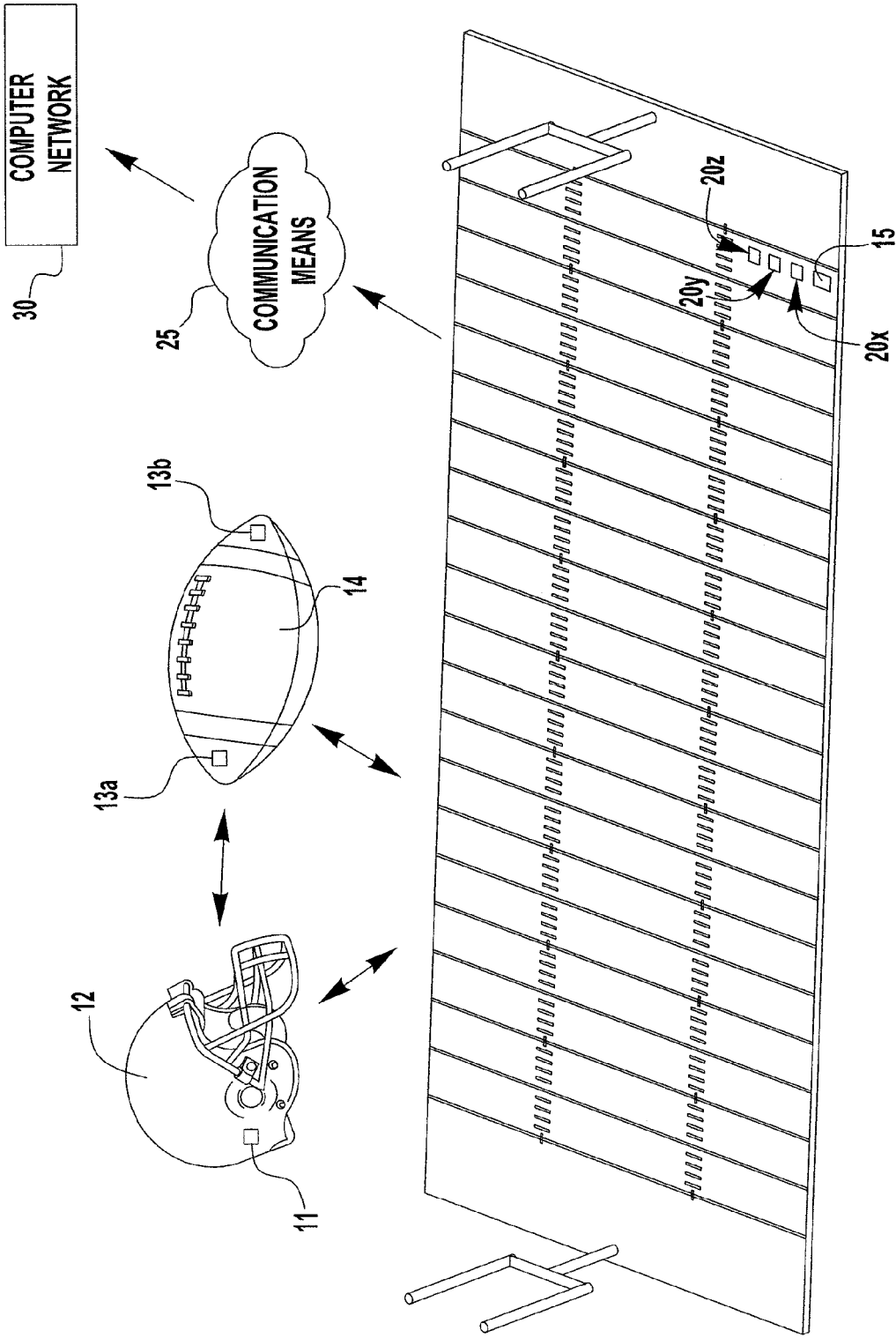


FIG. 2

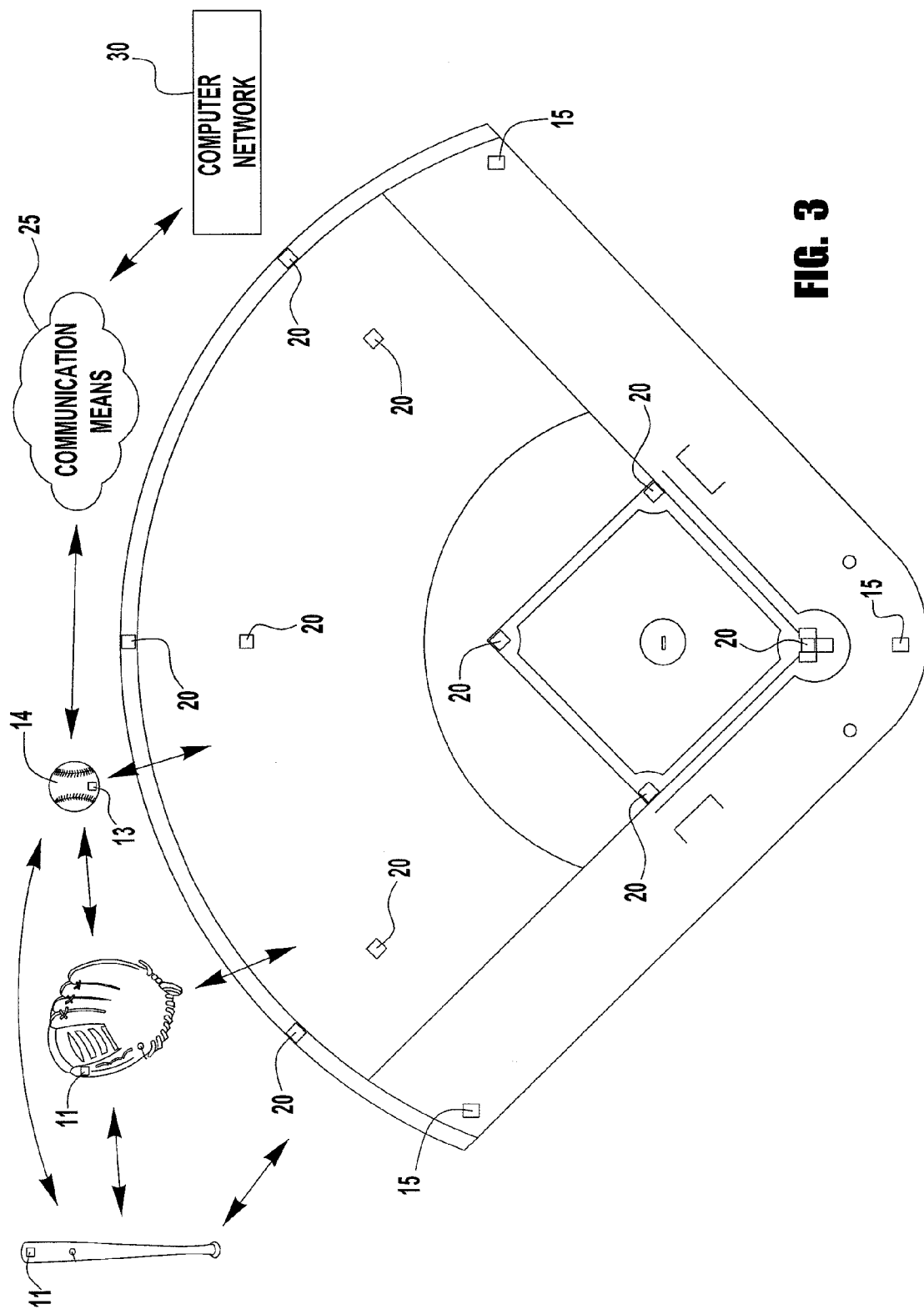


FIG. 3

ACTIVE SPORTS TRACKER AND METHOD

REFERENCE TO RELATED APPLICATION

[0001] This application claims priority of U.S. Provisional Application Ser. No. 60/749,499, filed Dec. 12, 2005, the entire contents of which are incorporated herein by reference.

FIELD OF INVENTION

[0002] The present invention relates generally to sports analysis systems and, more particularly, to an analysis system and method designed to track movements of players and the ball, monitor interaction between them, analyze performance, calculate statistics and perform other functions.

BACKGROUND OF THE INVENTION

[0003] Statistics are very important to sports especially professional sports such as baseball and football. Both live and past performances of a team and its individual players are followed in real-time and recorded by commentators and sports enthusiasts to calculate statistics for entertainment purposes and as a coaching aid. In baseball for example, various aspects of the game are monitored such as the speeds of the pitch, a hit, and base running.

[0004] Sportscasters typically rely on visual observations to track play-by-play action and consult news services or newswires for gathering related statistical information. This can be difficult during a game due to the speed of play and visual obstructions. Instant replays and guestimates based on sideline yardage or other "ghost scales," sometimes displayed on television with hockey or football for example, aid with this task, but can still fail to provide accurate, simultaneous information efficiently. Thus, there is a need to provide a system that accurately reports player and ball positions to calculate performance statistics and other information virtually up to the minute and to assist coaches objectively assess crucial play-calling decisions. There is also a need for a system that eliminates ball spot errors, reduces human error in statistical recording and scouting costs, and provides an ongoing performance history for sports teams and their players.

SUMMARY OF THE INVENTION

[0005] In general, the present invention addresses these needs by providing a system and method for actively tracking, processing and distributing data pertaining to player performance, movement of the ball and related statistics in a sports game. At least one active radio frequency identification ("RFID") transponder or "tag" (both active and passive RFID tags are generally referred to as "tags") is implanted into one or more items worn or used by one or more of the game players, such as a player's helmet or shoe. The active player tag contains a RFID chip attached to an antenna enabling it to receive and transmit its stored data to field readers located throughout the field of play. Field readers have an antenna and coupler configured to function to both retrieve stored data from player tags and transmit a signal to tags without requiring direct contact or a clear line of sight.

[0006] The game ball contains at least one passive RFID tag that transmits data collected thereon, such as its location

coordinates, back to the player tag. Game ball tag energizes from the electromagnetic field waves generated by the player tag. Optionally, a second passive tag is implanted at a position on the game ball spaced apart from the first tag, such as on opposite ends of a football. Each ball tag and player tag contains unique identification information. Active player tag also transmits data received from the ball tag to the field readers enabling players to interact with the game ball and the field.

[0007] Field generators capable of broadcasting a signal to "wake-up" or activate the player tag are located in every corner of the playing field. Typically there is just one generator per corner of the sport field, such as the end zone in football. Upon instruction by the generator's broadcast, or at pre-set intervals, the player tag transmits both player data and ball data to the field readers. The player tag reads the ball tag and transmits a signal transferring that data as well as player data to the field readers.

[0008] The field readers are generally positioned so that more than one will read the data at any given time. Preferably, field readers are positioned so that they are able to triangulate each active tag and the passive tags, enabling identification of the exact location of each tagged player and the game ball. In this way the tags continuously interact with the readers by transmitting them their stored data thereby creating an electronic grid capable of tracking the positions of the tags, and thus the tagged players and the game ball, virtually instantaneously. For instance, field readers are generally positioned in outer edges of the field of play, such as the four corners of a field having a rectangular shape. In a game of football for example, they may be positioned in the front corner of the end zone closest to the first yard line.

[0009] The field readers forward the collected data on a regular or as-requested-basis using communication means to a computer network arranged to analyze the data and provide interpretive information based on the data. This information includes, for example, the location of the players and the ball, their changes in speed and distances traveled, and the interaction between the tags. This interaction offers information sufficient for conducting comparative analysis between performances of players.

[0010] Thus, an object of the present invention improves analysis of a sports game and performance of its individual players by ensuring the accurate tracking of the ball and player movement and placement on the field. Based on this, an object in another example is to obtain and report up-to-the-minute data and statistical information stored for the ball and individual players. This may be advantageously used to provide management, coaches and players information needed to make game play decisions and to improve player and team skills. As accurate and precise information is vital for the success of any business or franchise team, another object in an embodiment of the invention is to enhance the ability to analyze the effectiveness and performance trends of current players which provides a potential for significant improvements to data available on individual players as they progress through their sports careers. An example of the system and method also eliminates ball spot errors, reduces human error in statistical recording, and provides a historical database and an ongoing performance history for sports teams and their players.

[0011] Other objects, features, and advantages of the present invention will become better understood or apparent

form the following detailed description, drawings and appended claims of the invention.

BRIEF DESCRIPTION OF THE DRAWINGS

[0012] FIG. 1 is a block diagram showing an embodiment of the system for actively tracking a sports game in accordance with an example of the present invention.

[0013] FIG. 2 illustrates an embodiment of the system employed for use with the game of football in accordance with an example of the present invention.

[0014] FIG. 3 illustrates an embodiment of the system employed for use with the game of baseball in accordance with an example of the present invention.

DETAILED DESCRIPTION OF EXAMPLES OF THE INVENTION

[0015] With reference to the drawings, FIG. 1 depicts a block diagram of an embodiment of the active tracking system. Player tag 11 is implanted into an item worn or used by a player. In a preferred embodiment, the tag is removably affixed to the helmet or sewn into a portion of the helmet or textile article, however, any suitable means of attachment is considered within the scope of this invention. Each player tag 11 transmits radio waves wirelessly to communicate, at regular intervals or upon instruction by one or more generators 15, with the ball tag 13, and an interface device or field readers 20 that are located in and around the sports field. Each player tag 11 powers and reads the ball tag 13 when game ball 14 is near player. The game ball includes any item used in the sport for scoring, such as a football, baseball or hockey puck, and need not be commonly referred to as a "ball." Along with this data, the current locational data or coordinates of player 12 are sent by signal from player tag 11 to field readers 20. As such, the player tag 11 is responsible for conveying the data and ball tag 13 does not transit any data to readers 20. Optionally, at least one passive reader is also implanted into an item worn or used by a player participating in the sport.

[0016] Tags and readers are configured to operate at a compatible frequency. Readers 20 are arranged so that more than one receiver is capable of accepting a tag 11 signal at any given point during game play. Preferably, readers 20 are arranged in a triangular formation so that at any given time three readers 20 are positioned to receive the data from player tag 11. In an example, three or four readers 20 are located in each corner of the field. Appropriately positioning tags and readers for the sports game at play provides a highly accurate positioning solution. Readers 20 track and store this data, including the positions of each player tag 11 and ball tag 13, and communicate that data over communication means 25 to computer system network 30.

[0017] Computer system 30 comprises a database for storing data received from readers 20 over communication means 25, a storage medium containing instructions and a data processor to implement instructions. Computer system 30, preferably located off-site from the field of play, is equipped with software designed specially for the game of football, which enables the system to function accurately. The computer system has registered identification of the player tags 11. Upon receiving the data from the readers 20, computer 30, based on registered identification, interprets

the data into useful information. A user interface module provides an entry screen for users to enable, disable or manipulate functions of communication means 25, game play map displays, ball and player positions, and the calculation of statistics based upon data. Interface also provides an entry for users to elect other functions and specific data of interest. Computer network 30 is adapted to collect data from field readers 20 and control the operations of the generators 15. Computer network 30 maintains and analyzes this data and distributes resulting information. Data documenting time and location of the game ball, and first and second players, for instances, enable networks 30 to calculate the ball speed from the first location to a second and subsequent locations. The information shows where the ball moves and who is responsible for that movement as the game progresses.

[0018] Furthermore, data analysis can yield virtually any information that will give players, newscasters, sports enthusiasts, team owners, and coaches, among others, the ability to track and monitor a player's progression over time. Players and teams can be tracked game-to-game and season-to-season, by monitoring the interaction between the players, the ball and the field, the system generates statistical and performance data for individual players and displays the collected data to such individuals while a game is in progress and/or after its conclusion, through the use of specially designed software. One can identify positive or negative performance trends and develop targeted strategies for player improvement. Additionally, if implemented across a sports division such as, for example, NFL-wide, a performance database for players can be developed, maintained and transferred with a player as they move from one team to another or to different franchises thereby providing an ongoing performance history. The system further allows users to analyze a player's performance from game start to finish, such as first to fourth quarter, and optimize strategies based the statistical knowledge, such as when and where a player will likely break down or underperform.

[0019] The present system is adaptable to most any sport. In particular, the system is used for football, baseball, basketball, hockey, golf, rugby, soccer and tennis. It can also be implemented in the courts of indoor gymnasiums and adjusted to accommodate a variety of games suitable for the particular court.

[0020] In an example, several players are equipped with at least one ball tag 11. Player tags 11 have reception capabilities to receive frequency of 433 MHz in a range of at least 100 feet. Typically, player tags 11 will only receive data from the game ball 14, if they are within distance to the ball, at least, in part, because the ball tags 13 are powered by the player tags 11. Thus, the ball 14 is constantly looking for an active player tag 11, such as on a helmet, to power it. Player tags 11 rely on a power source, such as a lithium-ion replaceable watch battery, and are designed to transmit a signal when the power source is in need of replacement. Additional communications can be made by player tag 11 if desired, such as for indicating if the tag is removed from contact points, if the temporal environment exceeds ideal or other predefined limits, or contains an LED that blinks when called. Preferably, player tags 11 are the general shape of a cylinder or square, fairly small in size, for example 34 mm×32 mm×12 mm; have a weight of about 11 grams; and are encased in durable casing, for example an acrylonitrile

butadiene styrene (“ABS”) case material. Player tags **11** have a user memory of about **0-256** Kbit.

[0021] In an example, ball tags **13** are passive tags that require no power source. They function to transmit information stored thereon by inductive coupling when placed within a specific electromagnetic interrogation field generated by an RFID reader at a specified frequency. Ball tags **13** are powered by the player tags **11**. The ball is constantly looking for a player tag or helmet to power it. The ball tags **13** can be set to read continuously or upon detecting movement of the player. At such instruction, player reader registers the time and the active player tag transmits the information. In a preferred embodiment, they are configured to operate a frequency in the range of about **865-868** MHz or about **902-928** MHz depending upon the receiving frequency of the active player tags **11**. Ball tags **13** have sufficient memory to record the position of ball **14** upon request by generator **15** and/or readers **20**. For example, ball tag **13** has of general protocol of EPC UHF class 1 Gen 2 for **150 18000-6** and an EPC memory allocation of about 96 bits.

[0022] Generators **15** activate or “wake up” player tags **11** and ball tags **14** by transmitting a radio frequency. Such transmission frequency can be at about 433 MHz. Preferably, the transmission range of generators **15** is at least 100 feet to tag **11** and **13**. Generators **15** also communicate with readers **20** at, for example, a radio frequency of about 916 MHz-927 MHz or 868 MHz. Ideally, the frequency provides a communications range of at least 100 feet to and from readers **20**. A link connects the field readers **20** with the active **11** tags, which communicate with ball **13** tag to record and send ball tag **13** data to readers **20**, and will be maintained provided the tags do not extend beyond the read range. Generators **15** are equipped with or without antennas. Use of antennas necessarily dictates the size of generators **15**, which, for an example are about 67 mm×108 mm×28 mm without antennas and about 67 mm×108 mm×159 mm with antennas. They can weight approximately 128 grams and be housed in an ABS case material. Additional features are optionally added such as Red LEDs and/or Green LEDs. Red LEDs can light up while transmitting data and receiving packets of data to or from readers **20**. Green LEDs can be lit while transmitting data packets to tags **11** and **13**. Optionally, generators **15** have a motion detector that may be set for particular play parameters during game play. Readers **20** have read and write capability to player tag **11** and ball tag **13**. Their transmission frequencies are similar, if not the game, as those of generators **15**. However, in an example readers **20** have a frequency range of about 100 feet to tags **11**, **13**, and about 280 feet from tags **11**, **13**. Readers **20** have a power source. For example, readers **20** use a 12 volt 1.5 amp battery. They communicate via ethernet or WLAN. Optionally installed on readers **20** are indicators, such as LEDs to identify communication status. For example, RF LED indicates while receiving data packets form tags **11**, **13**; HOST LED lights up when sending validated tag data to the computer system; ACCESS LED lights up when transmitting data to tag **11** or **13**; and

[0023] POWER LED lights up when the reader **20** is powered.

[0024] Computer network **30** has a server for processing data and a data storage system arranged to provide analytical and interpretive information based on data provided through

communication means **25** from readers **20**. Communication interface **25** includes, for example, Ethernet or wireless network, and can include any means of transferring such data. Computer system **30** runs software, such as an application software program, specially designed for the system and for the game parameters of a particular sport with which the system is being used. For example, software, generally referred to in RFID technology as middleware, resides on the computer network **30** server between the field readers **20** and desired applications. The middleware filters data received from readers and passes on that which is useful for desired applications, including results of data analysis. In an example, computer system **30** uses an API written in ANSI C and C# (C Sharp) that can be used in the NET environment and supports NET C++, Visual Basic and C#. It can be run on all Windows operating systems. The middleware can be designed to accommodate game rules and statistical range of teams. It can be manipulated and used as a powerful coaching tool and aid to making critical decisions during game play. The computer network can optionally include a memory for storing previously obtained data about a sport game and generating a database of historical performance for the game.

[0025] A method of tracking and analyzing the performance of a sports game is also included. The method generally comprises removably affixing at least one RFID tag and least one reader on or in an item worn or used by a player participating in the game, and removably affixing at least one RFID tag on or in the game ball. A plurality of field readers are positioned on or underneath the field of play for said sport and in a manner appropriate for receiving data from said player tag. A computer network is provided having a communication interface with the field readers and that is operative to receive data from the field readers and has a display and a memory for storing the data. Data stored on the tags is transferred to the field readers and to the computer for computing desired information about the game. Optionally, a plurality of generators are positioned on or underneath the field of sport play and capable of activating play tag, ball tag, or both. The further step of displaying a portion of the database in response to an operator request is used. This may include a visual representation of the movement of said player, said ball or both during said game. In an example, the further step is provided of developing a database of player performance statistics. In another example, the further step is provided of receiving historical performance data statistics and developing a database of player performance statistics. That optionally includes the historical performance statistics.

EXAMPLE 1

[0026] An example of the invention incorporates the system into the game of football. As illustrated in FIG. 2, player tag **11** is inserted into an item **12** worn by a player. Preferably player tag **11** is implanted into the helmet or jersey of a player, including those of the quarterback, receivers and running backs. Two passive ball tags **13a** and **13b** are embed into the game ball **14**, in this example, one on either end of the football.

[0027] Readers **20x**, **20y** and **20z** are positioned in the front corners of the end zone closest to the playing field (as shown in FIG. 2 in one corner). In another example, readers **20x**, **20y** and **20z** are scattered underneath the field to form

Cartesian planes across the field consisting of XYZ coordinates. Player tags **11** and football tags **13** are designed to interact with both each other and RFID readers **20**. Player tags **11** will interact with the football **14** via ball tag **13** and the field at the same or essentially the same time.

[0028] Readers **20** communicate data including the movement, position, interaction of each read tag retrieved from player tags **11** and ball tags **13** over wireless network **25** to a computer network system **30**. Computer system processor analyzes the data according to software instructions and converts or compiles the data into useful information for game leagues, franchises, broadcasting agencies, etc.

[0029] In a further example for the game of football, the system uses active player tags **11** operating on either a 916 MHz, 927 MHz or 868 MHz frequency that have a read range of at least 100 yards. Ball tags **13** include ultra high frequency passive tags operating on about a 13.5 MHz frequency and have a read range of at least 3 feet. Intelligent field readers **20** are equipped with on-board computing power and can filter data, store information and execute commands. Readers **20** communicate with tags **11** and **13** using a variety of protocols, and can read tags using different frequencies. External computer system **30** runs software specially designed for the system. Computer **30** gathers and interprets the information into useful data. For a football coach who is constantly making decisions throughout game play could receive information with respect to various data including score, field position, downs, yards to first down, yards run and distance thrown, for examples. Over time, this data includes historical data. The data can be manipulated using computer models and simulations, which can be designed to accommodate NFL rules and statistical range of NFL teams.

EXAMPLE 2

REAL TIME SCENARIO

[0030] In a game of football, active tags and readers are implanted into the helmets of the quarterback, receivers and running backs. A passive tag is provided on the football. When the football is snapped to the quarterback, the football tag will recognize the quarterback and that transmits data collected thereby. The player tag will begin recording data for analysis. For example, this information includes various statistical and performance information such as how far and fast he drops back in the pocket, and how far and fast he throws the ball, and the football location. If the quarterback throws the football to his wide receiver, the football tag will record the distance traveled and the velocity of the pass. Once the wide receiver catches the pass, the football tag will stop recording for the quarterback, and go back to the point of origin of the wide receiver. There it will begin recording how far and how fast the wide receiver ran through his pattern to receiver the pass, and how far he travels after the completion. Receipt of this data enables the computer system process on-going or live game action. This will aid users eliminate human error in statistical recording and ball spotting errors, and to ensure equal play through the duration of the game. Additionally, the information will provide a coaching aid in statistical analysis of the players, and a new level of statistical data, which is unattainable through the current way of obtaining data.

EXAMPLE 3

[0031] In another example, the system and method are employed with a baseball game as generally illustrated in FIG. 3. Two active player tags **11** are embedded into an item worn or used by each player to be tracked. Tags **11** are include in their helmets. Passive tag **13** is embed in the baseball. Readers **20** are positioned throughout and underneath the baseball diamond in a formation suitable for collecting player tag **11**. Readers **20** are positioned such that at least three readers are within range of any tag to be read, or, optionally, by triangulating player location and ball location. The operation and functionality of this system is very similar to the football system.

[0032] While the foregoing has been set forth in considerable detail, it is to be understood that the detailed embodiments and Figures are presented for elucidation and not limitation. Process variations may be made, but remain within the principles of the invention. Those skilled in the art will realize that such variations, modifications, or changes therein are still within the scope of the invention as defined in the appended claims.

What is claimed is:

1. An active sports tracking system for tracking and monitoring player performances and movement of the ball in play in a sport game, said system comprising:

- a. at least one first radio frequency identification ("RFID") player tag implanted into an item worn or used by a player participating in said sport, said player tag having a unique identification;
- b. at least one first RFID ball tag implanted on said ball, said ball tag having a unique identification and being configured to communicate with said player tag;
- c. a plurality of generators positioned on or underneath the field of play for said sport, being capable of activating said player tag;
- d. a plurality of field readers positioned on or underneath the field of play for said sport and in a manner appropriate for receiving data from said first player tag; and
- e. a computer network having a communication interface with said field readers, and being operative to receive data from said field readers.

2. The system as set forth in claim 1, wherein said player tag is an active tag and said ball tag is a passive tag.

3. The system as set forth in claim 1, wherein said player tag is enabled to receive and transmit stored data to said field readers located throughout the field of play.

4. The system as set forth in claim 1, where said ball tag is configured to transmit data collected thereon to said first player tag when said first player tag is within an appropriate range.

5. The system as set forth in claim 1, wherein said field readers are configured to transmit a signal to said first player tag without requiring direct contact or a clear line of sight.

6. The system as set forth in claim 1, wherein said item is a helmet, jersey, shoe or accessory item worn by said player.

7. The system as set forth in claim 1, further including a second player tag implanted into an item worn or used by another player participating in said sport, said player tag having a unique identification;

8. The system as set forth in claim 1, wherein said field readers are generally positioned so that more than one of said field readers are capable of receiving data from said first player tag at any given time during said game.

9. The system as set forth in claim 1, wherein said field readers are generally positioned in a cartesian plain of said field, arranged to triangulate a signal from said first player tag at any time during play of said sport, or both.

10. The system as set forth in claim 1, where in at least one generator is positioned in each corner of said field of play for said sport.

11. The system as set forth in claim 1, wherein said sport is selected from the group of sports consisting of football, baseball, basketball, hockey, golf, rugby, soccer and tennis.

12. The system as set forth in claim 1, further including a second RFID ball tag implanted at a position on said ball spaced apart from said at least one first RFID ball tag.

13. The system as set forth in claim 1, wherein said communication interface between said field readers and said computer system includes wireless or Ethernet.

14. The system as set forth in claim 1, said computer network further including software enabled to provide analytical and interpretive information based on data provided from said field readers.

15. The system as set forth in claim 1, said computer network further including software enabled to generate performance statistics of said players as a function of data collected by said field readers, wherein such statistics include distance or speed traveled by said player or said ball.

16. The system as set forth in claim 1, said computer network further including a memory for storing previously obtained data about a sport game and generating a database of historical performance for said game.

17. A method of tracking and analyzing the performance of a sports game played by at least one player and a ball, said method comprising the steps of:

a. removably affixing at least one RFID tag on or in an item worn or used by a player participating in said game;

b. removably affixing at least one RFID tag on or in said ball, said ball tag being configured to communicate with said player tag;

c. providing a plurality of field readers positioned on or underneath the field of play for said sport and in a manner appropriate for receiving data from said player tag;

d. providing a computer network having a communication interface with said field readers, being operative to receive data from said field readers, and having a display and a memory for storing said data; and

e. transferring data stored on said tags to said field readers and from said field readers to said computer for computing desired information about said game.

18. The method in claim 17, further including the step of providing a plurality of generators positioned generally on or underneath the field of play for said sport, being capable of activating said player tag.

19. The method in claim 17, further including the step of displaying a portion of said information in response to an operator request using a visual interface, including numerical data, a visual representation of the movement of said player, said ball or both during said game.

20. The method of claim 17, further including the step of developing a database of player performance statistics.

21. The method of claim 20, further including the step of receiving historical performance data statistics, and wherein the step of developing a database of player performance statistics includes the historical performance statistics.

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