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(54) **GAMING TABLE ACTIVITY SENSING AND COMMUNICATION MATRIX**

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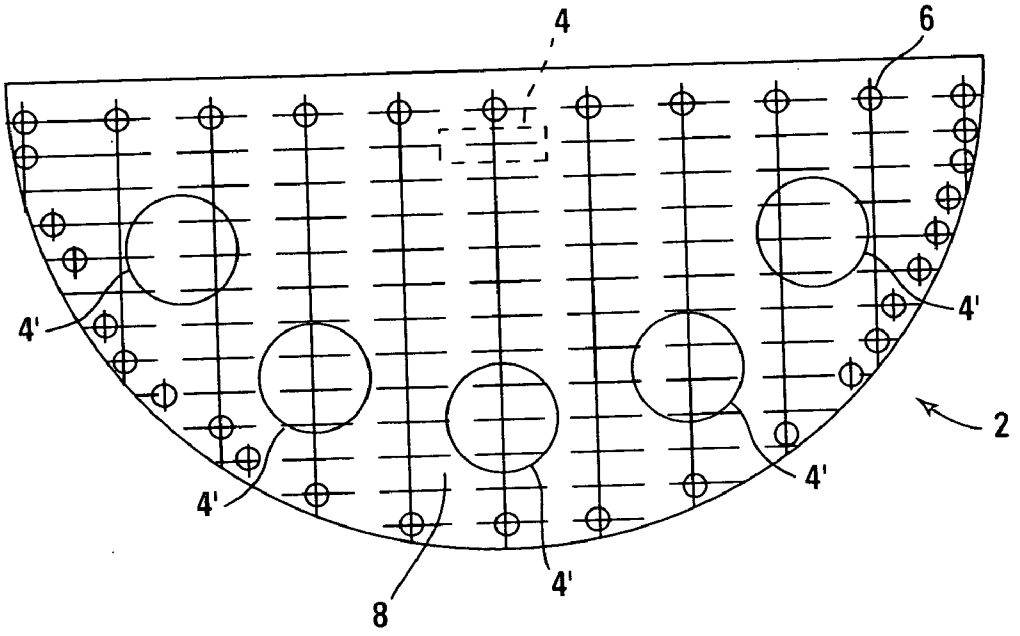
(57) **ABSTRACT**

An apparatus and a method enabled by the apparatus perform a method of measuring wagering activity on a gaming table. The method comprises providing at least one grid of sensors positioned over an area defined by the surface of a gaming table to sense the presence or absence of gaming elements on the gaming table surface. The sensors sense gaming elements (e.g., playing cards, gaming chips, tokens, player cards, etc.) on the gaming table surface. Signals are sent from the sensors (preferably to a logic control device) indicating the presence or absence of the gaming elements. The logic control device sends signals to a processor in response to receiving the signals from the sensors, and the processor storing information from said signals from the logic control system indicating the presence or absence of gaming elements on the casino table surface.



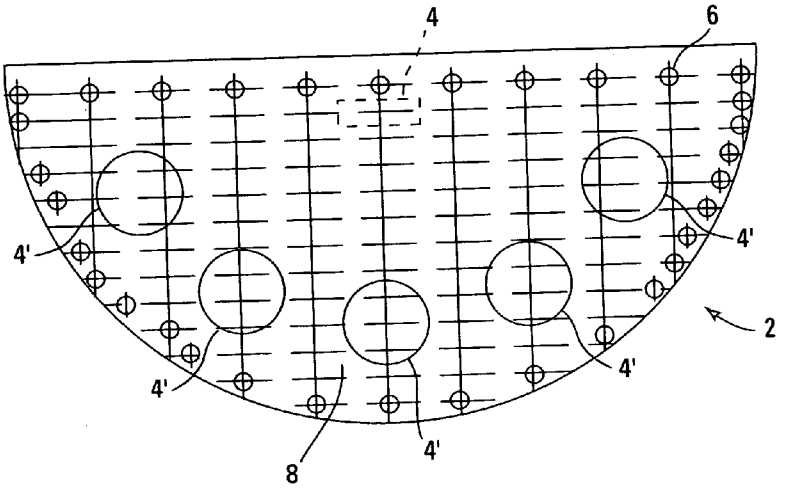


Fig. 1

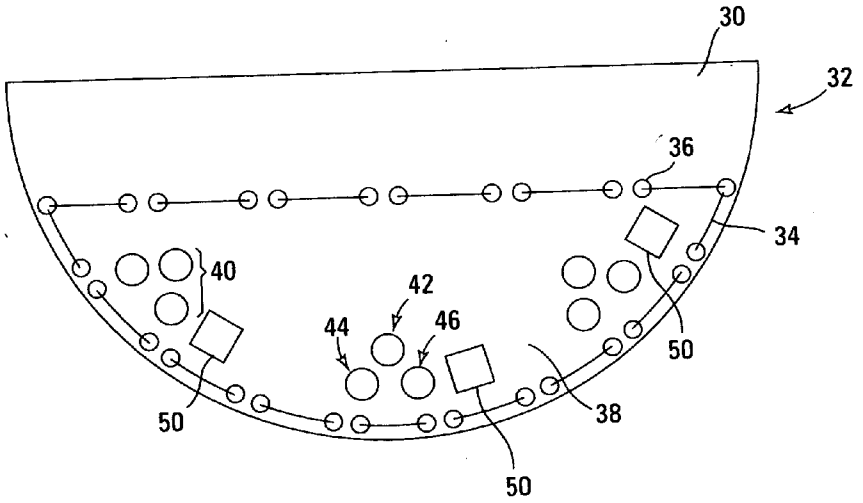


Fig. 2

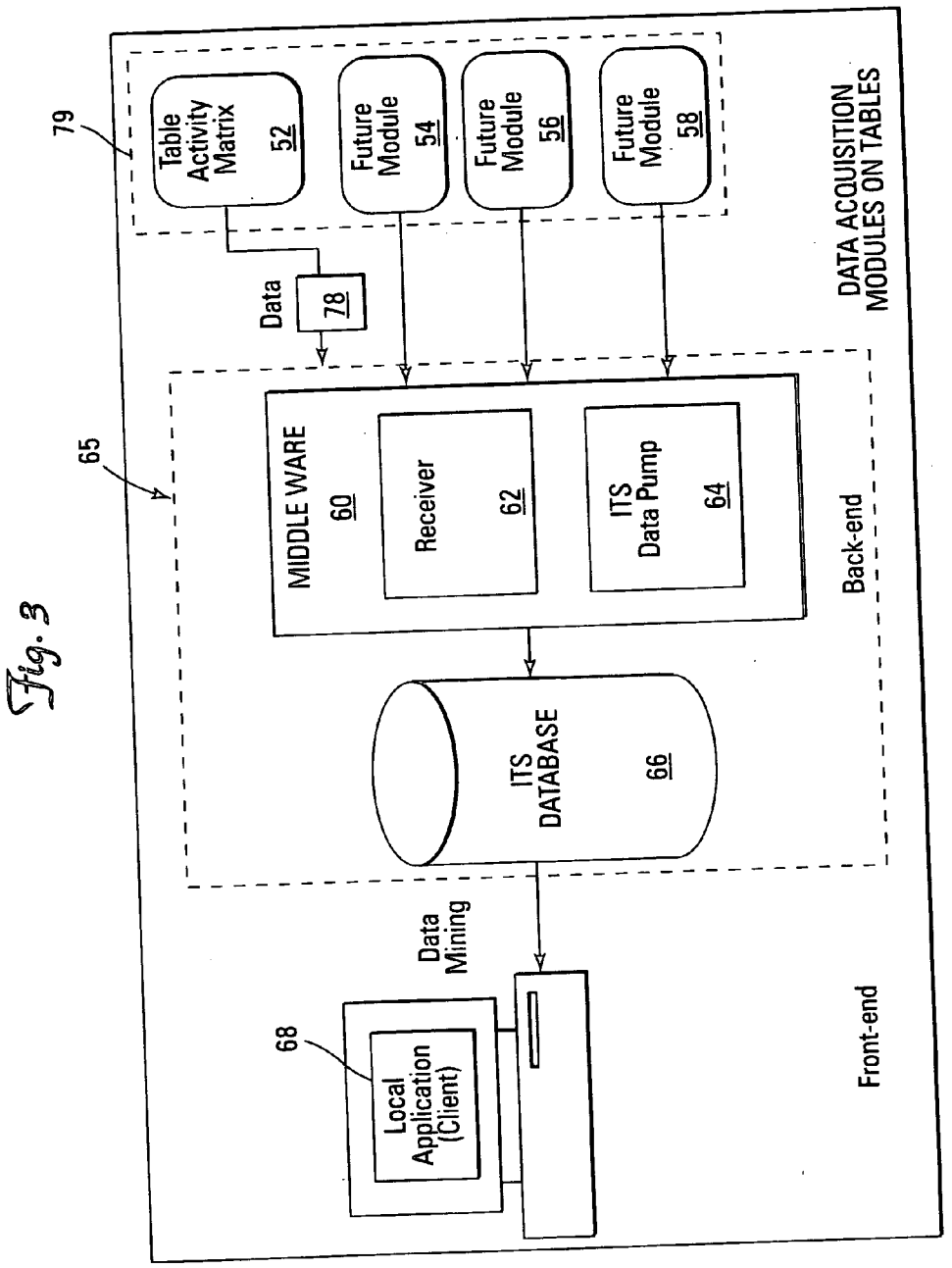

79
Table Activity Matrix 52
Future Module 54
Future Module 56
Future Module 58
DATA ACQUISITION MODULES ON TABLES
Data 78
65
MIDDLE WARE 60
Receiver 62
ITS Data Pump 64
Back-end
ITS DATABASE 66
Data Mining
68
Local Application (Client)
Front-end

Fig. 3

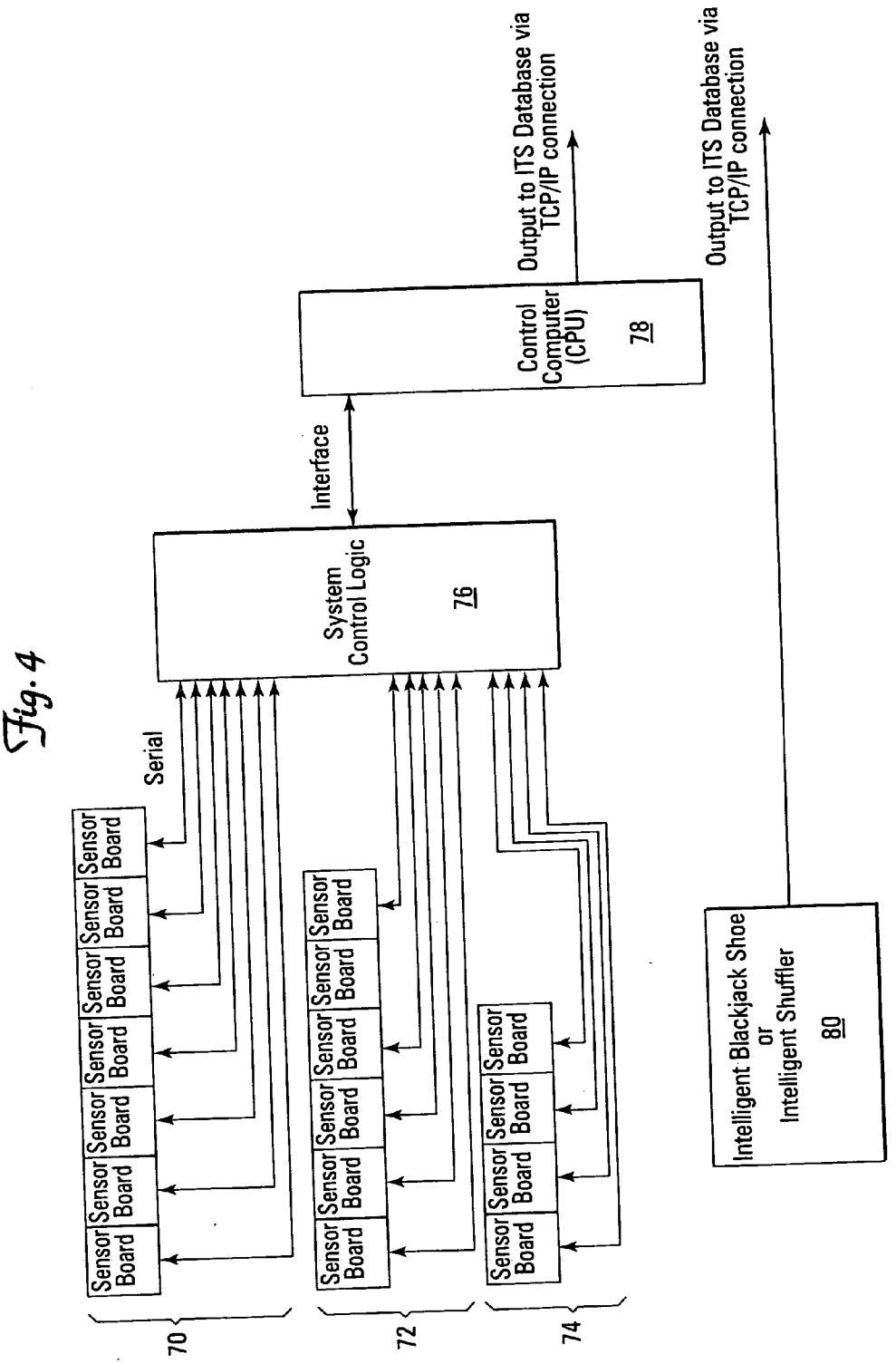

Output to ITS Database via TCP/IP connection
Output to ITS Database via TCP/IP connection
Control Computer (CPU)
78
Interface
System Control Logic
76
Serial
Sensor Board
70
72
74
Intelligent Blackjack Shoe or Intelligent Shuffler
80

Fig. 4

Fig. 5

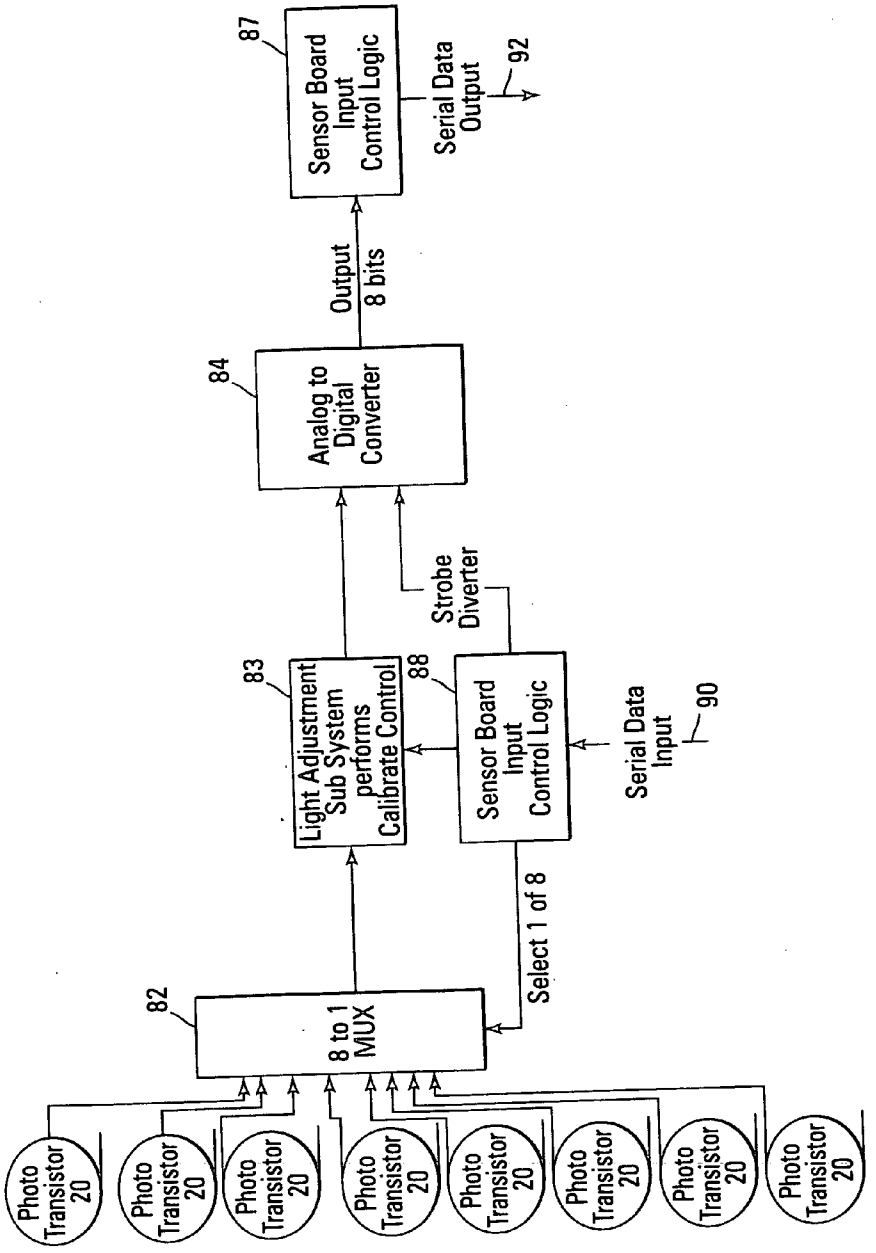


Photo Transistor 20
Photo Transistor 20
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Photo Transistor 20
Photo Transistor 20
Photo Transistor 20
82
8 to 1 MUX
Select 1 of 8
83
Light Adjustment Sub System performs Calibrate Control
88
Sensor Board Input Control Logic
Serial Data Input
90
Strobe Diverter
84
Analog to Digital Converter
Output 8 bits
87
Sensor Board Input Control Logic
Serial Data Output
92

GAMING TABLE ACTIVITY SENSING AND COMMUNICATION MATRIX

BACKGROUND OF THE INVENTION

[0001] The casino environment is undergoing significant changes. From a completely labor intensive environment, with live dealers, live security, and physical cards, with security provided by casino personnel, the casino is rapidly moving towards a highly automated electronic environment. Wagers on live gaming tables can be sensed, cards read, cards shuffled, hands read, commands sent from controls, component performance monitored, player activity monitored, dealer activity monitored, identification or players and dealers verified, jackpots incremented or decremented, state of the game or the state of components reported, game results determined or verified, hands verified in discard compartments, rounds of play counted, payouts calculated, a history of results displayed, and many other events and data relating to the operation of a table, pit or casino can be electronically provided.

[0002] There has been some resistance to the implementation of these more automated systems, and those reasons include the initial costs, the maintenance costs, and the perceived need for costly technical support staff to maintain the systems. Where more sophisticated components require service, or new components are to be added to the system, the level of technical skill and the degree of complexity of the work needed to implement the addition increases dramatically. Additionally, the down time to a table or pit that can be caused by the introduction or new components can be significant, further increasing the effective cost of the system.

[0003] The proposed systems have also been complex and sophisticated in their software and communication requirements. Known systems also tend to require significant component intelligence at each table just to support the communication function between components. At least these factors would lead to significant resistance within the industry for the installation of the more highly automated systems.

[0004] In the gaming industry, significant gambling occurs at live table games that use playing cards and a live dealer. Exemplary live table games include blackjack, poker, poker variants such as Let It Ride® stud poker, baccarat, casino war and other games. There are a number of proprietary or specialty live table card games which have developed, such as Fortune Pai Gow poker®, Let-It-Ride® stud poker, Three Card Poker® game, Four Card Poker® game, Caribbean Stud® poker and others. These and many other games all involve play using playing cards. The cards are dealt by a live dealer to the players, to a flop and/or to the dealer. The use of playing cards provided by a live dealer has a number of associated limitations and disadvantages that have long plagued the casino industry. Some of these are of general concern to all or most card games. Others are problems associated with the use of playing cards in particular games. Some of the principal concerns and problems are discussed below.

[0005] The use of playing cards at live table games typically involves several operational requirements that are time-consuming. These operations are conveniently described as collecting, shuffling, dealing and reading of the cards. In many card games there is also a step of cutting the deck after it has been shuffled. In the collecting operation, a live dealer typically collects the cards just played at the end of a hand. This is done in preparation for playing the next hand of cards. The cards in known systems must often be collected in the specific order in which they had appeared in the play of the game and must also be collected in a specific orientation, such as all cards being in a facedown or face-up condition. The cards also are typically straightened into a stack with the long sides and short sides aligned. These manipulations take time and are not typically appreciated by either the dealer or players because they distract from the play and entertainment value of the game. The use of physical cards also adds a regular recurring cost to play of the game in the wear on decks of cards that must be replaced every few hours. In many games the cards collected at the end of the hand are deposited into a discard rack that collects the played cards until the time a new stack is obtained or the stack is shuffled. In some games the cards are immediately shuffled into the stack either manually or using a card shuffling machine. More typically, the cards are collected and then shuffling is performed later by the dealer or a shuffling device controlled by the dealer.

[0006] When shuffling is needed, it involves a break in the action of the table game and consumes a significant amount of time. Shuffling is also the most time consuming operation in preparing for the next hand. Thus, shuffling is of substantial financial significance to the casino industry because it requires significant time and reduces the number of hands that can be played per hour or other period of time. The earnings of casinos are primarily dependent upon the total number of hands played. This is true because the casino on average wins a certain percent of the amounts wagered, and many or most casinos are open on a 24-hour basis. Thus, earnings are limited by the number of hands that can be played per hour. In light of this there has been a significant and keen interest by casino owners to develop practices that allow more games to be played in a given amount of time. Accomplishing this without detracting from player enjoyment and desire to play the game is a challenging and longstanding issue with casino owners and consultants in the gaming industry. The use of high quality shuffling machines, such as those produced by Shuffle Master, Inc. (Las Vegas, Nev.) as shown in U.S. Pat. Nos. 6,655,684; 6,651,982; 6,588,751; 6,658,750; 6,568,678; 6,325,373; 6,254,096; 6,149,154; 6,139,014; 6,068,258; and 5,695,189 that have significantly reduced the problem in down time.

[0007] The amount of time consumed by collecting, shuffling and dealing is also of significance in private card games because it also delays action and requires some special effort to perform. In private games there is also some added complexity due to card players remembering or figuring out which player had previously dealt and who should now shuffle and re-deal the cards as needed.

[0008] In the gaming industry there is also a very significant amount of time and effort devoted to security issues that relate to play of the casino games. Part of the security concerns stem from frequent attempts to cheat during play of the games. Attempts to cheat are made by players, dealers, or more significantly by dealers and players in collusion. This cheating seeks to affect the outcome of the game in a way that favors the dealer or players who are working together. The amount of cheating in card games is significant to the casino industry and constitutes a major security

problem that has large associated losses. The costs of efforts to deter or prevent cheating are very large and made on a daily basis. Many of the attempts to cheat in the play of live table card games involve some aspect of dealer or player manipulation of cards during collection, shuffling, cutting or dealing of cards. Thus, there is a need for methods and apparatus that can be used in the play of live table card games that collect data that can be used to reduce the ability of the dealer and/or players to cheat by manipulation of playing cards.

[0009] Of greatest concern are schemes whereby the deck is stacked and the stacked deck is used to the collusive player's advantage. Stacked decks represent huge potential losses since the player is aware of the cards which will be played before play occurs and can optimize winnings by increasing bets for winning hands and decreasing bets for losing hands. It is also desirable to provide decks or groups of cards where card counters are disadvantaged because of the reduction in their ability to track distributions of cards in the group of cards being used for play. Continuous shufflers, in which cards are reintroduced into the group of cards being used without first unloading all of the cards in the machine, helps to eliminate that aspect of improper behavior at the gaming table.

[0010] Casinos have recognized that their efforts to reduce cheating would be improved if the casino had comprehensive information on the cards which have been played, the amounts bet, the players and dealers involved and other information about actions which have taken place at the card tables. This is of particular importance in assessing the use of stacked decks. It is also important where card tracking is occurring. Additional explanation about card tracking is discussed below. The information desired by the casinos includes knowing the sequence and exact cards being dealt. It would be even more advantageous to the casino if physical cards and live dealers could be eliminated, as this would remove almost all major existing methods of fraud from casino table card games.

[0011] Some attempts have been made to acquire and record card game activity. Current technology involves cameras that are mounted above the tables to record the action of the card games. The disadvantage of this approach is that not all cards dealt are easily imaged from a camera position above the table because some or all of the cards are not dealt face-up, or are hidden by overlying cards. Although house rules in some casinos may require blackjack games to reveal all cards so that the order of dealt cards can be imaged, other casinos do not.

[0012] In card games such as poker, hands are not always revealed. The covered cards of the players do not allow the rank, suit or order of dealt cards to be ascertained from an above-table camera or on table mounted cameras.

[0013] Other camera imaging systems monitor wagers, such as the optical monitoring systems disclosed in Fishbine U.S. Pat. No. 5,781,647, Schubert U.S. Pat. No. 6,313,871, and Soltys U.S. Pat. Nos. 6,663,490, 6,652,379, 6,638,161, 6,595,857, 6,579,181, 6,579,180, 6,533,662, 6,533,276, 6,530,837, 6,530,836, 6,527,271, 6,520,857, 6,517,436, 6,517,435 and 6,460,848,

[0014] Even where cameras are used, their use may not be effective. Such cameras may require time-consuming and tedious human analysis to go over the videotapes or other recordings of table action or require the use of software that is complex and imprecise. In some present systems, some human study may be needed just to ascertain the sequence of cards dealt or to determine the amount of betting or to confirm software determinations from camera read data. Such human analysis is costly and cannot economically be used to routinely monitor all action in a casino card room or table game pit.

[0015] For the above reasons, the video camera monitoring techniques have found very limited effectiveness as a routine approach for identifying cheating. There has also been relatively limited use as a serious analytical tool because of the difficulty of analysis. Such camera surveillance techniques are of limited effectiveness as a deterrent because the analysis is completed after the player is gone from the table. Additionally, many cheats have a working knowledge of their limitations and utilize approaches that are not easily detectable by such systems.

[0016] As mentioned above, video camera monitoring and recording has been used to detect cheating and card counting. The tape recordings serve as evidence to prove the cheating scheme. However, in the past, this has generally required other evidence to initially reveal the cheating so that careful analysis can be performed. More routine and general screening to detect cheating has remained a difficult and continuing problem for casinos. This is also a human intensive review, with both video monitoring security personnel and live personnel watching the players and apprehending players at the tables.

[0017] The most significant cost in operation gaming tables is the personnel costs. A number of attempts have been made to automate systems to reduce the need for pit staff, or other staff that are directly or indirectly involved in the operation or maintenance of the games.

[0018] Casino equipment suppliers have attempted to overcome the complex problem of data acquisition on live gaming tables in a number of ways. One solution has been to provide electronic simulations of casino table card games. Such systems are shown in U.S. Pat. No. 4,397,509 (Miller); U.S. Pat. No. 4,614,342 (Takashima); U.S. Pat. No. 4,995,615 (Cheng); U.S. Pat. No. 5,470,080 (Naku); and Published U.S. Patent Applications 2002/0169013 (Serizawa); 2003/0199316 (Miyamoto); and the like. These systems do not require a dealer, and include individual monitors for display of the players' hands and the dealer hands. This approach allows for electronic data acquisition, but provides a high cost solution to the problem

[0019] Another approach has been to provide an automation of card handling, with a live dealer and the use of actual gaming chips. Sines U.S. Pat. Nos. 6,651,985 and 6,270,404 are titled "Automated system for playing live casino table games having tabletop changeable playing card displays and play monitoring security features." Sines U.S. Pat. No. 6,165,069 is similarly titled "Automated system for playing live casino table games having tabletop changeable playing card displays and monitoring security features." The Sines patents describe a video gaming table that requires the use of a live dealer, even though virtual cards are used. The Sines system includes bet/chip sensors on the table and requires the use of actual chips.

[0020] U.S. Pat. No. 5,934,998 (Forte and Sines) and U.S. Pat. No. 5,586,766 (Forte and Sines) describe a computer

controlled gaming table for playing blackjack. The system uses physical cards and the game is run by a physical dealer. This system provides a count display (e.g., LED display) at each player position to show the player count and dealer count (as appropriate) that is determined from reading the rank and suit of the physical cards. Physical playing chips are also used; with no credit wagering capability.

[0021] U.S. Pat. No. 5,586,936 (Bennett et al.) teaches a ticketless control system for monitoring player activity at a table game, such as blackjack. Physical cards and physical chips are used. Player identity cards identify each player entering play at a table, and a separate ticket printer issues a results ticket at the end of play or reads the ticket at the beginning of play.

[0022] U.S. Pat. No. 5,941,769 (Order) describes gaming equipment for professional use of table games with playing cards and gaming chips, in particular for the game of blackjack. The system automatically registers and evaluates all phases of the game automatically. This is achieved by a card shoe with an integrated device for recognition of the value of the drawn cards (**3'**) (optical recognition device and mirroring into a CCD-image converter); photodiodes (**52**) arranged under the table cloth (**51**) in order to register separately the casino light passing through each area (**53**, **54**) for placing the gaming chips (**41**) and areas (**55**, **56**) for placing the playing cards (**3**) in dependence of the arrangement or movement of the jettons (gaming chips) and playing cards on the mentioned areas; a device for automatic recognition of each bet (scanner to register the color of the jettons, or a RFID-system comprising a S/R station and jettons with integrated transponder); an EDP program created in accordance with the gaming rules to evaluate and store all data transmitted from the functional devices to the computer; and a monitor to display the run of the game and player wins.

[0023] U.S. Pat. No. 5,770,533 (Franchi) describes a casino operating system for controlling the flow of funds and monitoring gambling activities in a casino or a gaming establishment utilizing a network of computers, including a central computer and individual game computers. Each player receives an encoded betting card from the cashier. At the games, each player position is equipped with a control panel including a card reader into which the betting card is inserted. The control panel also includes an electronic screen and keyboard. From the control panel, the player may place a bet and perform all options available to the player in the particular game. The system records the hands dealt to each player and the winner, and credits or debits the player's betting card accordingly. In an alternative embodiment, the casino operating system allows the players to use chips to place bets instead of the above-described betting card. The chips are marked or encoded so that they can be counted once final bets have been placed to determine the amount of each player's bet. These "smart" RFID chips transmit an identification signal enabling the value of the chips to be counted by a remote sensor once final bets have been placed to determine the amount of each player's bet."

[0024] U.S. Published Patent Application No. 20030087694 (Storch) describes a fully automatic table game player tracking system for Blackjack and other casino games wherein players have individual betting positions on the table. An individual B&W CCD chip reading turret is placed inches in front of each player's betting position to scan wagered chips using ambient casino lighting. The turret also has a "comp" light to indicate to the player at the beginning of every hand that his bet was credited for his complimentary services (meals, room, entertainment, etc.), thus delivering to the player extra gaming satisfaction with every hand.

[0025] According to a Mikohn advertisement, its "Safe-Jack" secure blackjack system employs special gaming chips that each carry an embedded computer microchip. According to an advertisement of the gaming chip manufacturer, Bourgogne et Grasset of Beaune, France, the computer microchip is an ASIC integrated circuit linked to a small coil, which receives energy and interrogation signals through electromagnetic waves emitted from an outside antenna/reading device and transmits data back to the reading device. The SafeJack system is advertised to read and display all bets and payouts, and to include a light at each player position to indicate a win, push or loss.

[0026] Published U.S. Patent Application No. 20050054408 (Steil et al.) describes a system and method for monitoring playing cards in a live casino game by reading card attributes stored in each playing card at a player position with a radio frequency reading system. Each card has a radio frequency identification tag containing at least value and suit attributes. The tracking of the dealt cards to each player position occurs in sequence and based upon wagers placed monitors play of the live card game according to rules of the live card game. This Published application provides RF components to individual playing cards to track the movement of cards.

[0027] All patents and Applications described within this document are herein incorporated by reference in their entireties.

SUMMARY OF THE INVENTION

[0028] An apparatus and a method of measuring gaming activity on a gaming table is described. The method comprises providing at least one grid of sensors positioned over an area defined by at least a portion of the surface of a gaming table to sense the presence or absence of gaming elements on the gaming table surface, and to sense automatically decisions made at the gaming table. The sensors can sense one or more of the presence of a gaming element, its size, shape and purpose on the gaming table surface, Nonlimiting examples of gaming elements include playing cards, gaming chips, tokens, dice and the like. Signals are sent from the sensors (preferably to a logic control device) indicating the presence or absence of the gaming elements. The logic control device sends signals to a processor in response to receiving the signals from the sensors, and the processor storing information from said signals from the logic control system indicating the presence or absence of gaming elements on the casino table surface.

[0029] In alternate embodiments, a microprocessor is provided as an alternative to the logic control device. The data from the logic control device can be further analyzed to identify the nature of the object (i.e. whether the object is a wagering chip, a card, dice or other gaming element, based on shape and/or the number of sensors blocked), to determine player decisions (i.e.—if a player doubled down or split pairs, if a side bet was made, if a bet was increased, if

a bet was withdrawn, for example), and to sense the receipt of gaming objects to a particular player position on the table (i.e. if the dealer dealt a hit card, the system can detect which player received the extra card). For purposes of this disclosure, the phrase "sensing the nature of an object" on a gaming table encompasses all of the above activities.

[0030] Although the table activity matrix of the present invention is capable of collecting a wide variety of data for analysis, it is often desirable to combine such a system with a card rank and/or suit reading shoe or card reading shuffler. By dealing cards from card rank and/or suit reading shoe, the system can collect information regarding the hand composition, and provide the data necessary to analyze player proficiency. For example, a review of the data after a hand of play might reveal whether a player followed ideal play procedures, or deviated significantly from the recommended play procedures. This data might be used by a casino to rank the player and as a further basis for awarding complementary services, or comps.

[0031] In another embodiment, the matrix system also includes wager denomination and/or amount sensing. Adding a wager amount sensor such as an RFID antenna and transponder can advantageously allow for the collection of data relating to amounts won/loss on a particular hand of cards. Alternately, optical imaging systems can be used in combination with or in place of RFID chip reading.

[0032] An automated casino table card game system of the present invention is capable of communicating with a local computer, a network computer, a network database, and the like. Although the examples described in this disclosure send information to a control computer prior to sending the data to an upstream database, the present invention contemplates packaging the data, date stamping the data and sending the data to a remote game controller and/or database rather than to a local controller. In this instance, the local controller would be replaced with a simple microprocessor that performed only basic functions such as date stamping the data, storing small amounts of information in memory (such as a card count, for example) and the communication hardware and software. Communications may be via TCP/IP or by other means such as WiFi, satellite systems and the like. The method of data transfer can be by any known means.

[0033] Systems of the invention may have a number of different but interrelated functions and capabilities. Among the various independent capabilities that may be available within the operation of the system may include: a) determining hand composition; b) determining player actions taken during play, such as splitting pairs, doubling down, placing an insurance bet, increasing a bet, decreasing a bet, taking hit cards and the like; c) positioning of chip reading antennae that differentiate between specific types of wagers; d) RFID antennae that operate in sequence to distinguish wagers; e) the combination of RFID antennas to determine first total bets present and additional wagers made, f) Sleeping chips that are programmed to go into a sleep mode once read in the course of a hand; and g) the combination of circuit boards to collectively identify optical position of wagers and RF reading of the value of wagers on a gaming table.

BRIEF DESCRIPTION OF THE FIGURES

[0034] FIG. **1** shows a schematic drawing of one embodiment of a table activity matrix system according to the disclosure provided herein.

[0035] FIG. **2** shows a second embodiment of a table activity matrix system according to the disclosure provided herein.

[0036] FIG. **3** shows a specific example of a data acquisition system using the table activity matrix of the present invention.

[0037] FIG. **4** shows a schematic of communication system for a family of sensor boards, system control logic (e.g., the FPGA or ASIC), a CPU and an intelligent card handling system.

[0038] FIG. **5** shows a typical, but only exemplary, basic connection diagram between the transistors, multiplexers, converter and control logic of one exemplary sensor board.

DETAILED DESCRIPTION OF THE INVENTION

[0039] A system according to the teachings herein is referred to as a table activity matrix system because of the general nature and distribution of activities on the table over large areas of the table as opposed to being discrete functioning elements (e.g., a shuffler, card delivery shoe, card receiving tray and coin drop) as is typically the manner of automatically sensed events. These other point sensing elements may be used in combination with the matrix system of the invention. The table activity matrix was initially developed as a component of a table game data acquisition system capable of tracking the presence and movement of objects (especially, but not exclusively chips and/or cards) within the confines of a single table. Nonlimiting examples of other table activity that can be monitored by the present system includes dice location, marker location, player card location, dealer card location, common card location, chip location, player and dealer hand movement and positioning, the placement of refreshments on the gaming table surface, the receipt of tips by the dealer, the initial hand shuffling of cards by the dealer, hand cuts of cards by player and dealer, the exchange of currency for betting chips, and the like.

[0040] The table activity matrix in one form of the invention is used in combination with an intelligent card handling device (e.g., card rank and or suit reading shufflers, delivery shoes and card receiving trays) such as, but not limited to, those devices disclosed in U.S. patent application Ser. No. 10/958,209 (filed Oct. 4, 2004; Grauzer et al.); Ser. No. 10/622,321 (filed Jul. 17, 2003 (Grauzer et al.); Ser. No. 09/967,500 (filed Sep. 28, 2001; Grauzer et al.); Ser. No. 10/971,755 (filed Oct. 24, 2004; Grauzer et al.); and Ser. No. 11/059,300 (filed Feb. 14, 2005; Grauzer et al.).

[0041] The table activity matrix is preferably also used in combination with a control computer to collect comprehensive information relating to the play of a casino table card game. The computer used for data analysis can be local or a network computer. For simplicity, the computer is shown in the drawings as a local computer **78** (see FIG. **3**) but the invention contemplates the use of a network computer also.

[0042] One possible use for the information collected from the table activity matrix and card reading shoe is to assist in

the automatic determination of the skill of a player. Another possible use is in determining how to determine an appropriate award of complementary services to the player. Other uses might be to verify a bonus hand before a payout is made, and to verify that accurate pays were made on a particular table. Although the table activity matrix system combined with a card reading shoe can be used with many different types of games, its primary application is for the play of blackjack, where player's skills are more important to the house than in any other card game, as a player's skill in blackjack can directly affect casino profits.

[0043] A dealer identification device, for example could also be combined with the present table activity matrix for the purpose of collecting information that can be attributed to dealer activity and or skill. For example, a casino might learn that a certain dealer deals many more hands to his or her customers than the average, and on this basis, the casino might provide a service award, pay increase or bonus to the dealer. On the other hand, the system might effectively identify collusion between a player and a dealer, and provide the casino with cause to report the activity to law enforcement authorities.

[0044] Player identification devices such as card readers, or player tracking systems, for example could similarly be combined with the table activity matrix of the present invention so that player-specific data may be extracted and analyzed.

[0045] The technology of this invention relates to methods of automatically identifying gaming activity on a casino gaming table. The casino gaming table, and especially casino gaming playing card tables use automated sensing, communication and/or response equipment to assist in the performance, control, monitoring and data storage of events and activities at the casino game table. The automated system may include a) hardware and or software to activate a data collection process, b) one or more wager value sensors (e.g., RFID antennae), c) a table activity matrix and d) an external computer to at least store the data. The stored data can be extracted and analyzed to determine what activities are taking place or took place on a gaming table.

[0046] Depending upon the nature of the game, particularly the distribution and types of different wagers, different matrix structures could be used. For example, certain games are not played against a dealer hand so the matrix structure would not need to be present beneath the surface proximate the dealer.

[0047] The overall objective of the matrix system is at least to enable automated reading at least one of a) the presence of all wagers placed on the table and b) the location of dealt cards. The matrix can also be used to distinguish among the types of wagers placed (i.e. an ante bet, a raise wager, a side wager, etc.), and where indicated, the respective times (relative to the play of the game) when the wagers are placed. One example of the matrix system enables automated chip value reading functions to be provided when first chip reading functions are completed.

[0048] A number of different aspects of the invention can be individually described.

Determining Hand Composition

[0049] For example, if the composition of each hand is to be collected, the table activity matrix is combined with a card rank and or suit reading card shoe. When the initial card is removed from the shoe, the matrix is energized. If the matrix is combined with bet detection devices such as RFID antennas, bets are detected at this time. At this point in time, the number of cards dispensed is equal to the number of wagers, times 2, plus two cards for the dealer. The system also knows the destination location of each card, and can verify that the card reached the destination by sensing the card presence with the activity matrix. As each card is removed from the shoe and placed in the destination, the matrix generates a signal that represents the location of the dealt card and associates this card with a player position and the rank and/or suit of the card. If a player identification device is provided, the identity of the card can instead be associated with the player rather than the player position. This information can be associated with a time and the information stored in the memory of a local computer or in a distal database. After the initial two-card hands are dealt, the receipt of the dealer's second card (recognized by card position) signals that the initial hands have been dealt. Any wagers made after the initial two-card hand can be characterized as a double down, insurance or split wager. Hit cards are then associated with a hand according to a sensed location of the receipt of the card.

Determining Player Actions Taken

[0050] In the play of casino games, players have many actions that they can take. They may make decisions such as splitting pairs, doubling down, placing insurance bets, making side bets, increasing bets, decreasing bets, taking hit cards, rolling dice, spinning wheels, and other actions, depending on the game rules.

[0051] The table activity matrix of the present invention senses this activity. For example, if the player's initial hand became twice its normal width, the processor would interpret the doubling of the number of blocked sensors and the proximity of the blocked sensors to determine that the player had split a pair. If the system included a card-reading shoe, the system could also anticipate a possible split by first identifying the two-card hand as a pair and then testing for the split. The test would involve comparing the number of blocked sensors in the player card area, before and after the time allowed to make a split decision. This test would be sufficient to establish a split if the players were instructed to stack the first two cards.

[0052] The system can detect the act of doubling down by looking for additional blocked sensors in the wager sensing area. The analysis may or may not include an analysis of the shape of the area of blocked sensors. It is desirable to provide a sensor grid with evenly spaced apart sensors, and enough sensors such that the shape of a gaming object can be determined by examining the blocked sensor patterns.

[0053] The test for determining whether a double down bet was placed could therefore include a) an analysis of the shape of the blocked sensor area, and b) the assignment of the particular blocked sensors to a function, i.e.—for instance, assigning a bank of sensors to an area designated for double down wagers, or both, or examining the shape of the cards after the first and final hit card is received and arranged horizontally against the vertically positioned and stacked initial two-card hand.

[0054] The system is capable of identifying the presence of an insurance bet. Insurance bets are typically placed on an

arc on the layout designated for insurance wagers. This arc is typically between the dealer play area and the player areas. A predetermined number of sensors located beneath the arc could be preassigned to the function of sensing insurance bets. The system might first perform a shape analysis to verify that an insurance bet in the form of one or more chips is being placed, rather than an irrelevant object such as an ash tray or a beverage glass.

[0055] The game play rules might allow a player to make an optional side bet. A certain area of the layout can be designated for the receipt of optional side bets, and the sensors within that designated area are assigned to that function. The test for determining if a side bet wager was placed would therefore be a determination of whether one or more of this assigned particular set of sensors is blocked.

[0056] If the game rules allow the player to increase a wager, as in the case of doubling down in blackjack, or making a raise bet in poker, the computer system might compare the wager areas before and after the wagering round takes place to determine if the size and shape of the area (or blob) being covered by the sensors has changed. The software might also verify that the covered area is irregular rather than rectangular to infer that additional chips were placed on the felt.

[0057] The matrix can also be used to detect card movement and placement for the purpose of determining player decisions. For example, if a player doubles down, he or she is eligible for only one additional hit card. This hit card is positioned horizontally on the table, and comes into contact with the vertically positioned initial hand. By combining the initial two cards with the third card, the system can perform an extra test to confirm that the player has doubled down, rather than split pairs, basing the test on the shape of the blocked area or blob.

Using Chip Reading Antenna

[0058] By combining a chip reading antenna of the type suitable for reading RFID wagering chips with the matrix of the present invention, the computer can obtain much more detailed information relating to play of a game. Depending on the positioning of the chip reading antenna, the system can determine the nature of the bet, i.e. whether it is an ante, a raise, a side bet and the like, and the amount wagered.

Using Timing to Determine the Nature of a Wager

[0059] It may be possible to use an antenna within each player position, and use timing as a criteria for distinguishing between the types of wagers. For example, the initial round of wagering is sensed prior to the dealing of cards at t1, and if the game rules allow for additional wagering between the dealing of the second and the third card, for example, another scan is then taken before the third card is dealt, at t2. The amount of the initial wager is the value at t1 and the amount of the side wager is the value at t2, minus the value at t1.

The Use of Multiple Antennas

[0060] When RIFD antennas are combined with the matrix system of the present invention, it is sometimes desirable to position one or more antennas within the interior area of another antenna beneath the gaming table surface (i.e. on top of the table, but below the felt and any padding on the table), such that the antenna is invisible to the player. The larger antenna might represent a perimeter of the gaming table, a player-only wager perimeter area, a single player wagering area, a dealer specific area or other area. The perimeter antenna can be activated to determine the total amount of the wager, and then one or more antennas within the interior of the larger antenna can be activated to determine the amount of particular bets, such as a side bet. If for example the outer antenna surrounds the entire wager area of a particular player and the second interior antenna represents the side bet wager area, the value of the primary wager is the total wager amount minus the side bet amount.

[0061] It is also desirable to activate antennas at different times to prevent interference between the signals received by the antennas.

Sleeping Chips

[0062] When the matrix system of the present invention is combined with a RF chip reading system, and the number of chips is relatively high, it often takes more time than is desirable to obtain an accurate chip count/value determination. It might be desirable in some instances to send a signal from a device on the table to put a chip to sleep after the initial scan so that subsequent scans of the same area only sense additional wagers placed. This obviously would be appropriate for a game where multiple betting rounds are required or allowed, but would not be desirable in a game that allows players to withdraw bets.

The Use of a Matrix and RFID Chip Reading to Determine Wagering Activity

[0063] In some applications, it is desirable to use a combination of both position sensing and chip value reading in the same system. For example, the table activity matrix might be used to identify wagers made at the various betting locations to activate the particular live player positions so that further object/position/movement sensing takes place in that area only. It might also provide additional security to the game to read the value of the wager using a RFID chip reading antenna and then verify the presence of the bet using the matrix.

[0064] As shown in FIG. **1**, a casino table surface **2** is provided with a matrix of sensors **4** (only the perimeter sensors are shown), in which a plurality of individual sensors **6** (with circles shown thereon) form a field array covering the entire playing surface **8** of the table. It is to be understood that this equipment is normally positioned beneath the table felt and padding, but could be incorporated into the padding. At any rate, the sensors are invisible to the player. In one form of the invention, each sensor is uniformly spaced, forming a pattern of sensors over the surface of the table (as shown in FIG. **1**). It may be desirable to provide more densely spaced sensors in one or more areas of the table for improved sensing precision, depending upon the purpose. For example, it may be desirable to provide more closely spaced sensors in the wagering areas as opposed to the card areas because the size of a chip is smaller than the size of a card. This array can cover all or a portion of the surface of the gaming table. The specific locations where the array is present on the table is dependent on the game being played and the additional sensing equipment, if any being used. Objects present on the table will be interrogated with the particular sensing equipment provided.

[0065] For example, when one or more player betting area specific RFID antennas **6** are used, RFID chips (not shown)

are placed within the area bounded by the antenna **6** on the wagering surface. Typically, the RFID antennas are incorporated into a separate board that can be positioned over the matrix boards. The RFID boards typically have a plurality of apertures that allow the optical sensing devices of the matrix access to sensing activity on the table. Alternatively, the RFID board is constructed of material that is transparent to the sensors in the matrix boards. All chips in the betting areas will be sensed by antennas **6**. If a perimeter RFID antenna is used, all chips, whether being wagered or not, will be periodically interrogated by the matrix sensing system. At the same time or after the initial interrogation, the antennae/transponder/sensor system **6** is activated and will confirm the presence and sense the value of all wagered chips. Only the wagered chips will be interrogated by antennas **6**.

[**0066**] Some RFID chips have essentially unique identification numbers. Other chips are programmed with a denomination value, and or a casino property designation. Typically all of the information in the chip memory, whether the memory is read only, or read/write is read when the chip is interrogated by the antennas.

[**0067**] When the sensing system comprises an optical sensing grid, groups of sensors are typically arranged into an array on a sensor circuit board **4** that covers a specific area of the table. Multiple sensor boards **4** comprise the table activity matrix array. As is described in more detail below, multiple sensor signals are interrogated to determine at least one of the size, shape, position and identity of a specific gaming object. This is a simple mathematical process that can easily be programmed into a processor that receives the signals emitted by the sensors. The presence of chips can be read with respect to their precise position on the table **2**.

[**0068**] FIG. **2** illustrates another example of the table matrix of the present invention, the matrix covering only a portion of the total surface of the gaming table. As is shown in FIG. **2**, showing only the top surface **30** of the table **32**, an enclosed area **34** of sensors **36** (only the 'perimeter' sensors are shown) of the matrix system covers less than the entire top surface **30** of the table **32**. As the system here is not intending to read the presence of chips controlled by the dealer, or dealer controlled cards, only those portions **38** of the table top **30** where a player can control chips and cards is monitored. However, in the particular structure of wagering zone **40** shown, each player position (only three positions shown for convenience) has a set of three wagering positions **44**, **42** and **46** within each zone **40**. The set of multiple wagering positions may comprise (by way of non-limiting examples) and Ante wager position **42**, a Bonus wager position **44** and a Play wager position **46**. The matrix of sensors (not shown) underneath the surface of the table (similar to the matrix of sensors **4** shown in FIG. **1**) would be able to detect the specific position where chips are present on the table, and whether there is a single sensor under each wagering position, or whether the signals from surrounding wagers are mathematically treated (e.g., integrated, geometrically analyzed, averaged, vectored, etc.) to determine the location of the chip, the placing of a specific chip for a specific wagering purpose can be identified and stored/recognized by the processor ultimately receiving the information on the location of the chip.

[**0069**] Similarly, areas **50** could be designated as player card areas. Any interrogation of areas **50** would determine at least one of a) whether the area has an active player hand on it, b) if there is only a single hand, c) if there has been a split, d) if there has been a double down and e) if additional hit cards are taken. This analysis can be accomplished in a number of ways, not limited to shape analysis, whether one or more distinct objects are being sensed with in the designated area **50**, and the size of the area blocking the sensors.

[**0070**] The table activity matrix of the present invention feeds data into a data acquisition module **65**. A general schematic of one embodiment of a network-based data acquisition module is shown in FIG. **3**, wherein four data acquisition modules (the table activity matrix **52**, and three "future modules"**54**, **56** and **58** such as biometric sensors, motion sensors, RFID sensing systems and optical chip sensors/readers and card rank/suit readers) are present on the table, feeding signals and/or data to network-based middle ware **60** comprising a data receiver **62** and a data pump **64**. Each module **52**, **54**, **56**, **58** is in one form of the invention is part of a monitoring system **79** for one gaming table. The Middle Ware **60** sends the totality of the collected data as input to an Intelligent Table System (ITS) database **66** where all game related and player related information is stored. A network computer (not shown) can access the data and perform data analysis. Communication between the network computer and the modules on the gaming table can be one way, or two way.

[**0071**] Data can be accessed by a local computer **68** and data can be mined in this manner. The information contained in the database **66** is accessible by a network computer (not shown). The ITS database **66** may also be stored in local memory or more preferably, the data may be transferred via a network connection to a network database **66** as shown in FIG. **3**. Regardless of where the database resides, information may then be mined (searched) with specific search parameters, as with a player game strategy analysis software (e.g., Bloodhound® gaming software) by a network computer (not shown) accessible by a local client **68** to evaluate a player's skill, player historical win/loss record, betting habits, to determine the likelihood of card-counting or cheating, etc. The data can be combined with other data collected by the casino, such as dealer i.d., player tracking information and the like in order to perform player or dealer-specific analysis. Or the dealer i.d. and player i.d. devices could be added as modules **54**, **56**, **58** to the present system.

The Data Pump

[**0072**] An example of new import and export features were introduced in Oracle Database 10g, called Oracle Data Pump, which represents a radical departure from the client/server approach to which database users have grown accustomed over the past several generations of Oracle Database. The server now runs export and import jobs. You can load or unload massive amounts of data quickly using parallelization, and you can adjust the degree of parallelism on the fly. Export and import jobs are now restartable, so a failure doesn't necessarily mean starting over. The API is exposed and easy to use; it's simple to create an import or export job from PL/SQL. And once started, such jobs run in the background, but you can check status and make modifications, from anywhere, using the client utilities.

[**0073**] The architecture before Oracle Database 10g, (Oracle7 through Oracle9i) the import and export utilities

ran as clients and did the bulk of the work. Data being exported was read by the database instance, passed over the connection to the export client, and then written to disk. All the data was single-threaded through the one export process. Data volumes today are often magnitudes larger than when this architecture was first put in place, making that single export process a bottleneck because performance of an export job is limited by the throughput that the export utility can sustain.

[0074] With Oracle Database 10g and the new Data Pump architecture, all the work is now done by the database instance, which can parallelize the work in two ways: by creating multiple Data Pump worker-processes to read/write data being exported/imported, and by creating parallel I/O server processes to more quickly SELECT or INSERT that data. Gone is the single-process bottleneck.

[0075] Data Pump jobs are created, monitored, and adjusted using the new DBMS_DATAPUMP PL/SQL API. The new import and export utilities—impdp and expdp, respectively—are nothing more than command-line interfaces to the API. One can initiate a job—say, an export job—using the Data Pump export utility. One can then shut down the client, engage in distinct tasks, while the job is still running. Later the system can be reconnected to that same job, the status checked, and even the degree of parallelism can be increased to get more work done while other tasks are not on the system. At another time, one can decrease the degree of parallelism, or even suspend the job, to free up resources for alternative users during the day.

[0076] The ability to restart jobs is a desirable feature of Data Pump architecture. One can stop and restart a Data Pump job at any time, perhaps to free up resources for online users. One can also recover easily from file system space problems. If a data export fails for lack of disk space, one no longer needs to restart the job from scratch, repeating the first part of the work. Instead, one can attach to the failed job, add one or more new dump files, restart from the point of failure, and the task will resume. This is a huge benefit when working with large amounts of data.

[0077] Having the server handle all files I/O is a great boon for DBAs performing exports and imports remotely. It's easy enough now on UNIX-like systems (such as Linux) to telnet or ssh into a server, get a command prompt, and initiate an export or import job that actually runs on the server. However, that's not so easily done on other operating systems, Windows® OS being a notable example. Before Data Pump, to export a large amount of data from an Oracle database on Windows, one pretty much had to be sitting at the server console to issue the commands. The alternative of exporting over a TCP/IP connection is viable only for very small amounts of data. Data Pump changes all this, because even when initiating an export or import by running the new export and import utilities on a client, the job runs on the server; all the I/O happens on the server.

[0078] For security purposes, the Data Pump requires specifying target directories, those containing dump files that you wish to create or to read, using Oracle directory objects.

For example:

CREATE DIRECTORY export_dumps

[0079] AS 'c:\a';

[0080] GRANT read, write

[0081] ON DIRECTORY export_dumps

[0082] TO [operator name];

[0083] One starts an export using the new expdp utility. The parameters are not the same as for the old exp utility, so familiarize the operator with the new parameters. One can specify parameters on the command line, but for this discussion, parameter files are used. To export an entire schema, use the following parameters:

[0084] UMPFILE=gnis%U.dmp

[0085] DIRECTORY=export_dumps

[0086] LOGFILE=gnis_export.log

[0087] JOB_NAME=gnis_export

[0088] DUMPFILE specifies the file to which to write exported data. The % U syntax gives an incrementing counter, resulting in the filenames gnis01.dmp, gnis02.dmp, and so forth. DIRECTORY specifies my target directory.

[0089] LOGFILE parameter gives a name to the log file that is created by default for any export job. JOB_NAME gives a name to the job. Take care to specify job names that don't conflict with schema object names in the login schema. Data Pump creates a table known as the job's master table in the login schema with a name matching the job name. This table tracks the status of the job and is ultimately written to the dump file as a record of what that file contains.

[0090] Listing 1 shows an export job being started. One of the first things the job does is to estimate the amount of disk space required. After that estimate displays, press ctrl-C to get to an interactive export prompt, and then use the EXIT-_CLIENT command to return to the operating system command prompt. The export job is still running on the server.

[0091] Note that if a parallel export is desired and the operator wanted to spread I/O across two disks, one could make the following changes to the DUMPFILE parameter values and add the PARALLEL parameter and value as follows:

[0092] DUMPFILE=export_dumps01:gnis%U.dmp,

[0093] export_dumps02:gnis%U.dmp

[0094] PARALLEL=2

Note that in this parallel export, the directory is specified as part of the filename.

[0095] FIG. **4** shows a specific example within the generic concept of the teachings herein of a specific Matrix combined with a card handling device and a local computer for a blackjack table. One or more serial sensor boards **70**, **72** and **74** (three are shown in this example) are in individual (board-by-board) direct connection to a system logic control **76**. The system logic control need not be a processor or microprocessor or other processing capable element, but may be a field programmable gated array (FPGA) that acts as an interface between the multiple sensor boards **10** and a processor **78** (CPU). Processor **78** includes a network communication port. An intelligent card handling device **80** (e.g., an intelligent blackjack shoe, an intelligent shuffler, and/or intelligent discard rack) is in communication connectivity (e.g., TCP/IP) with a control computer **78** (CPU) via a network connection. Alternately (not shown) if the system is a local system, the card handling device **80** might

instead communicate with the local control computer **78**, but this is a less preferred form of the invention. When the system uses a local processor **78**, that processor is in communication with the ITS database **66** (shown in FIG. **3**) and middleware, for example communicating by way of a network connection, such as a TCP/IP connection. It is to be noted that Assignee's co-pending U.S. Patent Applications Nos. 20050062227; 20050062226; 20050051955; and 20050012270; and previously commonly assigned video games in 20050059459 contain FPGA intermediate circuitry. These applications are also incorporated herein by reference.

[0096] The configuration in FIG. **4** includes a multiple families of sensor boards, common system control logic **76** (e.g., the FPGA or ASIC), a CPU **78** and intelligent card handling system **80**. The intelligent card handling system communicates via a network connection (preferably via TCP/IP connections) to the CPU **78** and the sensors on sensor boards **10** communicate by the system control logic via serial interfaces. However, other known communication methods are contemplated. The sensor boards **10** and the intelligent card handling systems **80** perform a data acquisition function (as shown in FIG. **3**). The collected data (which in this instance may be matrix object sensing data, for example) in the system control logic **76** (e.g., FPGA, ASIC or other intermediary logic function) may be sent by serial interface to the CPU control processor **78**. Data from other modules **54**, **56** and **58** preferably send signals directly to a database **66** via network communication. All data and/or signals from the matrix eventually pass through or are collected by the CPU **78** from at least the object sensing elements shown in FIG. **4**.

[0097] The sensor board matrix represented as a non-limiting example shown in FIG. **1** may be constructed of a plurality of sensor boards **10** for use in at least collecting optical-based information on gaming elements (such as cards, chips, tokens, etc.). A typical sensor board in this construction might comprise hundreds of phototransistors and multiple multiplexers, a light correcting subsystem, an input control logic, output logic and one analog to digital signal converter. FIG. **5** shows a typical, but only exemplary, basic connection diagram between the transistors **20**, multiplexers **82**, light adjustment subsystem **83**, sensor board input control logic, **88**, sensor board output control logic **87**, and analog to digital converter **84** of one exemplary sensor board.

[0098] Each sensor board in this construction, where there is optical sensing (as opposed to audio sensing, RFID sensing, motion sensing, thermal sensing, etc,), contains multiple optical sensing elements **20** such as an array of phototransistors. These light sensitive phototransistors are able to detect changes in light intensity, and provide an indication of the presence or absence of objects covering the sensor. The transistors are preferably evenly distributed on the table's playing area to form a grid-like sensor matrix. The relative positioning of the optical sensors **20** need not be uniform in pattern, and it is preferable that the grid forms a distribution such that when any expected size object (e.g., a wagering chip of playing card) is placed on the table, it must contact at least one, and preferably multiple sensors, no matter how the expected size object is oriented on the table. There need not be a grid on an area of the table where no game play objects are to be placed, such as the shuffling machine area, card discard rack area, dealer's tray area, etc. But positioning a grid beneath such structures would provide an electronic signal confirming the presence of the structures, and might be desirable in some instances such as for inventory control and theft detection.

[0099] The sensor board(s) are in two-way communication with the control computer **78** in one embodiment, through the system control logic **76**. Each sensor board has at least one input signal **90** and one output signal **92**. For example, the sensor input board may receive a signal indicating that a card has been withdrawn from the card handling apparatus (e.g., the dealing shoe), and in response to that signal, it is activated to determine if a wager is present at its location. The input signal may also be generated by the CPU, sent to the sensor board input control logic through the system control logic. The output signal may be generated by the phototransistors **20**. The signal may preferably contain information relating to light intensity that each phototransistor has collected at its collection or sensing area.

[0100] All of the phototransistors are preferably connected to multiplexers (MXU) **82**. There may be several levels of multiplexer hierarchy, in which only the first level is connected directly to the phototransistors. The first level MUX **82** are then connected to a second level of MUX (not shown), and this progression may continue up through higher levels of the multiplexers. Finally, all of the phototransistors' data are converted (from one sensor board) into one signal. This signal is then fed into an A-D (analog to digital) converter **84**, which preferably has a light correcting subsystem **83**. The A-D converter with light correcting subsystem **83** collects signals from each sensor board, converts signals to digital format, and sends the signal out through the sensor board output logic **87**. All sensor board output signals are ultimately sent to the CPU through the system control logic **76**.

[0101] The system control logic **76** performs, for example, at least three major tasks. It calibrates sensors, reads data from sensors and creates the data (from signals or absence of signals) sent to the CPU. The system control logic **76** can associate the sensor signals with a location within the grid, object shapes or both. The control computer **78** is programmed to associate certain grid locations and shapes with gaming object identity and an intended use, such as area for receiving player cards, dealer cards, primary wagers, side bet wagers, split cards wager, double down wagers or an insurance wager. To assist in eliminating the potential for reading errors due to uneven light distribution, the system control logic is programmed to calibrate each sensor to compensate for ambient light variation using the light correcting system

[0102] The system control logic **76** reads the output signal sent from each sensor board **20**. By reading all output signals, the system control logic may be able to identify the coordinates of each sensor and its respective on/off (covered/not covered) condition. The collected sensor information generated by each sensor board is transmitted to the control logic, which is in turn transmitted to the control computer (CPU) in preferably a continuous manner, although it can be fed in batches periodically. When the data is sent continuously, to the CPU, it tends to not be date stamped. This may be provided at other locations (e.g., the CPU, or if not continuously, at the control logic). Based on

the combination of the signals from the card handling device **80** (preferably a card rank/suit reading shoe), the sensor boards and any wager sensing equipment module that may be present, the CPU may determine when to use this data and when to send control commands or state signal information to the sensor(s).

[**0103**] Further data analysis is possible. For example, the CPU might interpret the sensor information to detect the shape of the object being sensed, the fact that the object split into two separate objects over a given period of time, that the shape of the object changed, indicating an event such as a hit card after a double down, and the like. Numerous types of information can be derived from the combination of object present sensing, object shape analysis, object presence vs. time.

[**0104**] The intelligent card handling system has been referenced elsewhere in this text, as in U.S. Published Patent Application Nos. 20050062227; 20050062226; 20050051955; and 20050012270, for example. The card rank (and optionally suit for blackjack, where that tends to be superfluous, except for optional jackpot or bonus events) may be read by any reading system, generally referred to as a camera, although it need not be the traditional camera, but can be an area detector or the like that responds to radiation, visible or not, a bar code reader, an RFID reader, magnetic code reader, and the like. The card rank/suit information would probably be best sent directly to the CPU, although an intermediate system or element may be used. The presently preferred optical camera reads the cards as the leave the delivery area of the dealing shoe or the shuffler. In addition, the card handling device, as indicated above, may trigger the sensor boards to become active. When a card is read at the beginning of a hand, the first card or first series of cards may be used to activate or signal the sensor boards that would then respond by actively sensing for the presence of the object for which they are intended to sense. The shoe or shuffler may also be used to monitor the progression of the game and to reconstruct compositions of player hands and dealer hands, alone or in combination with an intelligent discard tray.

[**0105**] The control computer (CPU) **78** combines the information collected from the table by the matrix and is capable of identifying the presence of cards dealt to each player position and the dealer position. This information, along with information from bet sensors and card rank and suit reading sensors are sent to a database **66** where information can be mined at a user interface **68**. Information derived from the system can include an analysis of the types of wagers made at various times in the play of the game, player proficiency, etc. It can detect activities such as surrender, insurance, double downs, splitting hands, busts, blackjacks, and the like. An example of a commercial CPU that can be programmed according to the needs of such a Table Matrix system for blackjack is a GENE-6310, which features a 3.5 inch SubCompact Form factor, Onboard VIA Eden Series 400/667 MHz, C3 1 GHz EBGA mobile CPU; integrated AGP 2D/3D graphics accelerator; dual channel LVDS interface onboard; integrated AC97 2.0Sound-Blaster™ board-compatible legacy audio; 10/100 Base-T fast Ethernet; 2 or 4 COMs/1 parallel/4USBa/1 trDA; and capable of supporting CRT and 36 Bit TFT panels, NTSC/PAL TV output, and Type II compact flash memory.

[**0106**] In embodiments of the described technology, data transfer may be communicated through the use of a more traditional wired network or optionally via a wireless network. A wireless network requires an interface system that is capable of interfacing between a signal providing component such as the system output from the control computer as illustrated in FIG. **4**, and a wireless communication system with an ultimate signal destination. In some instances, such an interfacing capability is performed by elements of a "demarcation device," and specific examples of how the demarcation capabilities arise in different embodiments of the network interface systems are discussed below. Merely by way of illustration, such demarcation capabilities may derive from elements comprised by the following examples of demarcation devices: a set-top box (e.g., table node), which may be used as an interface between a customer's (player's) signaling appliance and a casino's communication network; broadband modems, including any format of wireless modems, each of which may be used to provide any signal, including but not limited to digital signals, analog signals, state signals, sensed event signals, and/or data signals within a gaming environment premises; integrated access devices; and the like. One particular demarcation device whose elements may be used to provide demarcation capabilities includes a network interface device ("NID"), described in detail below. In some instances, a demarcation device may additionally include other capabilities, including, for example, the capability to separate received communication information into discrete sets; the capability to process certain of the separated sets independently from other sets; and/or the capability to transmit different of the separated sets to different locations, perhaps through the use of different interfaces. Integration of one or more microservers with the NID has significant advantages when compared with solutions in which microservers are separate from the NID. For instance, separate microservers may require access to a customer premises for services and may be moved around and removed from the customer locations. By integrating the microservers with the NID, they are easily accessible by a technician and may be integrated in a secure fashion as described below that makes them nonremovable by others.

[**0107**] In describing embodiments of the technology, references to "player locations" are intended to refer to physical locations or structures at which a player engages in gaming. Wireless sensor networks as described herein will drive the next phase of explosive growth in the use of more automated systems in the gaming industry. Technological improvements and cost reduction of low-data rate transceivers, low power microprocessors, MEMS (microelectromechanical system) sensors, and embedded programming languages will unleash the development of a new class of fully autonomous computing and communications devices in form factors smaller than a box of matches.

[**0108**] One method described herein is for measuring wagering activity on a gaming table. The method may comprise providing at least one grid of sensors positioned over an area defined by at least a portion of the surface of a gaming table to sense the presence or absence of gaming elements on the gaming table surface; sensing with said sensors gaming elements on the gaming table surface; sending signals from the sensors to a logic control device indicating the presence or absence of the gaming elements; the logic control device sending signals to a processor in

response to receiving the signals from the sensors; and the processor storing information from said signals from the logic control system indicating the presence or absence of gaming elements on the casino table surface. The sensors may comprise optical sensors such as, by way of non-limiting examples, phototransistors. The logic control device need not and preferably does not process the signals from the sensors before forwarding signals to the processor, and is preferably selected from an FPGA and an ASIC. The method may be practiced where at least some sensors comprise RF antennae and emitters. This would be performed by providing at least one sensor to measure a first quantity or value of RF responsive gaming chips on a gaming table surface; optionally providing at least one additional sensor as an additional antenna sensitive to an RF responsive component on the table, reading chips associated with a specific wagering position for a specific wager type; determining an amount of at least one specific type of wager made as a specific wager type; and automatically verifying total amounts paid out to the player based upon chips amounts read on the gaming table.

[0109] The gaming table may include one or more antennas located within each player position. The gaming table may also include a perimeter antenna. The perimeter antenna is capable of sensing all chips on the table, including those chips not in play. Each player position may also include an antenna surrounding the entire wager receiving area, and may contain one or more additional antennas located within the player-specific perimeter antenna. The signals provided by the antennae may be sent to a logic control system, and the logic control systems sends signals to a data storage base. The signals may be generated by the logic control system from the signals provided by the antennae.

[0110] This table may also include a grid of object present sensors, such as those shown in FIG. **1**.

[0111] Both types of sensors may be sent to at least a first level of multiplexers to combine signals so that signals from multiple sensors can be sent to their respective logic control systems contemporaneously. The grid of RF sensors may send signals to at least a first level of multiplexers to combine signals so that signals from multiple sensors can be sent to a logic control system contemporaneously.

[0112] The technology described herein can be used with any of the systems in the gaming environment that use communication between components and processors or data storage elements. There is a vast array of technology with which these systems can be used, particularly following types of technologies that can be incorporated or provided in gaming environments, particularly casino table card game environments.

[0113] Examples of card handling systems useful as an additional module in the data acquisition systems of the present invention include: baccarat shoe structures such as the shoe described in application Ser. No. 10/958,209, filed Oct. 4, 2004, and in case Ser. No. 11/152,475, filed Jun. 13, 2005, a batch-style card shuffler such as Shuffle Master, Inc.'s MD-2 Card Shuffler with card reading capability, as described in U.S. patent application Ser. No. 10/623,223 filed Jul. 17, 2003, entitled "Card Shuffler with Card Rank and Value Reading Capability" assigned to Shuffle Master, Inc., a blackjack shoe such as the shoe described in pending application Ser. No. 10/958,208, filed Oct. 4, 2004, a continuous shuffler with card-reading capability, the shuffler having a structure described in U.S. Pat. No. 6,254,096, or a shuffler with hand-forming capability (with card reading), the structure described in U.S. Pat. No. 6,149,154. The above-identified examples of card handling systems are herein incorporated by reference in their entireties.

What is claimed:

1. A method of detecting gaming activity on a gaming table, the method comprising:

providing at least one grid of sensors positioned over an area defined by at least a portion of the surface of a gaming table to sense the presence or absence of gaming elements on the gaming table surface;

sensing with said sensors gaming elements on the gaming table surface;

sending signals from the sensors to a logic control device indicating the presence or absence of the gaming elements;

the logic control device sending signals to a processor in response to receiving the signals from the sensors; and

the processor storing information from said signals from the logic control system indicating the presence or absence of gaming elements on the casino table surface.

2. The method of claim 1 wherein the sensors comprise optical sensors.

3. The method of claim 2 wherein the grid of sensors is an array of uniformly distributed phototransistors.

4. The method of claim 2 wherein the optical sensors detect the presence of at least one of wagering chips and cards on the gaming table surface.

5. The method of claim 1 wherein the logic control device does not process the signals from the sensors before forwarding signals to the processor.

6. The method of claim 1 wherein the logic control device is selected from an FPGA and an ASIC.

7. The method of claim 1 of measuring wagering activity on a gaming table wherein at least some sensors comprise RF antennae and emitters, the method comprising:

providing a first antenna positioned to measure a first quantity or value of RF responsive gaming chips on a gaming table surface;

providing at least one additional sensor as an additional antenna sensitive to an RF responsive component within an area defined by the first antenna;

reading chips wagered within the area defined by the first antenna and reading all chips within the area defined by the at least one additional antenna; and

automatically determining the type of wagers made.

8. The method of claim 7 wherein the type of wagers made is selected from the group consisting of a primary bet, a side bet, a play wager, a double down wager and an insurance wager.

9. The method of claim 7 wherein signals are provided by antennae, the signals provided by the antennae are sent to a logic control system, and the logic control systems sends signals to a data storage base.

10. The method of claim 1 and further comprising sending data relating to the wagers made to a data receiver.

11. The method of claim 9 wherein the signals are data generated by the logic control system from the signals provided by the antennae.

12. The method of claim 1 wherein the grid of sensors send signals to at least a first level of multiplexers to combine signals so that signals from multiple sensors can be sent to a logic control system contemporaneously.

13. The method of claim 7 wherein the grid of RF sensors send signals to at least a first level of multiplexers to combine signals so that signals from multiple sensors can be sent to a logic control system contemporaneously.

14. An apparatus for playing a wagering game comprising:

a grid of multiple sensors for sensing gaming elements distributed within an area of an upper surface of a gaming table;

a logic control system in communication with the grid of multiple sensors to receive signals from the multiple sensors indicating the presence and absence of gaming elements; and

the logic control system in communication connection with a processor to send signals from the logic control system to the processor so that the signals are at least stored by the processor.

15. The apparatus of claim 14 wherein the sensors are selected from the group consisting of optical sensors and RF sensors.

16. The apparatus of claim 15 wherein the sensors comprise phototransistors.

17. The apparatus of claim 16 wherein the phototransistors are in communication with at least a first level of multiplexers in a communication path before signals from the phototransistors are sent to the logic control system.

18. The apparatus of claim 17 wherein the logic control system comprises at least one FPGA or ASIC.

19. The apparatus of claim 18 wherein the logic control system is incapable of executing code on the signals from the phototransistors before sending signals to the processor.

20. The apparatus of claim 16 for measuring activity on a gaming table wherein:

at least some phototransistors are provided as circuit boards bearing a plurality of phototransistors, and there are a multiplicity of the circuit boards comprising at least a first and second circuit board spaced on an area used for sensing a position of gaming objects on a gaming table; and

a third circuit board bearing at least one RFID antenna, wherein the third circuit board comprises apertures indexed to the optical sensors in the first and second circuit boards, such that when the third circuit board is positioned over the first and second circuit boards, the phototransistors can sense activity on the gaming table.

21. A method of monitoring game play activity on a gaming table, including the steps of:

providing a matrix of gaming object presence sensors on a gaming surface, at least two object presence sensors within the matrix for sensing at least two separate gaming objects;

placing gaming objects on the gaming surface;

sensing the gaming objects on the gaming surface;

characterizing at least one of a shape, a size, a location of each gaming object based on the sensed information; and

using the characterization to determine game play activity.

22. The method of claim 21, wherein the gaming objects are selected from the group consisting of: a card, a wager, a die, a marker and currency.

23. The method of claim 21, wherein the object presence sensors are selected from the group comprising optical sensors and RF sensors.

24. The method of claim 21 and further comprising providing a card handling device capable of reading rank and suit, selected from the group consisting of a card shuffler, a card reading shoe and a discard rack.

25. The method of claim 21, wherein the game play activity determined is selected from the group consisting of: determining a location of a dealt card, determining that a wager has been made, distinguishing between a primary bet and a side bet, determining if a player split a pair, determining if a player doubled down, determining if a player placed an insurance bet, determining if a player increased a bet, determining if a player withdrew a bet, determining if the player took one or more hit cards and determining if the player busted.

26. The method of claim 24, wherein the game play activity determined is selected from the group consisting of: the rank and/or suit of each card in a player's initial hand and the rank and/or suit of additional cards dealt to a player's initial hand.

27. The method of claim 21 and further comprising the step of providing a plurality of RFID antennas capable of reading the value of wagers placed within an area defined by an antenna.

28. A method of measuring wagers on a gaming table surface comprising:

providing at least one RFID antenna and RFID transmitter on a gaming table for sensing wagers made with RFID chips, the transmitter capable of sending signals to a RFID chip to alter the RF activity state of the chip;

sensing a value of the wagers by reading information on the RFID chips with the antenna; and

altering the activity state of the chip.

29. The method of claim 28, wherein the activity states of the chip are selected from the group consisting of an active mode and a sleep mode.

30. An apparatus for reading RF gaming chips on a gaming table, comprising:

A gaming table surface;

A first and second RF antenna on the gaming table surface, each with an area defined by the antenna, wherein the area of the first antenna is located within the area of the second antenna.

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