GAME APPARATUS WHERE DARTS ARE THROWN INTO A PROJECTED VIDEO GAME IMAGE AND SOFTWARE CONDUCTS THE GAME PROGRESS BY LOCATING THE DARTS WITH DIGITAL CAMERAS

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ABSTRACT

This invention describes an electronic amusement game where sensors locate the position of darts thrown by participants into a target board. The target board is not a traditional dart board but an uncolored dart board onto which is projected game images by a front projection monitor. The game locates the darts through the use of digital cameras that capture 2 dimensional images of the dart’s profile to establish coordinates. The software conducts game progress by incorporating the thrown dart’s position into the game itself. Any manner of game can be projected, including traditional dart games.
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CROSS-REFERENCE TO RELATED APPLICATIONS

[0001] Not applicable

STATEMENT REGARDING FEDERALLY SPONSORED RESEARCH OR DEVELOPMENT

[0002] Not applicable

REFERENCE TO SEQUENCE LISTING, A TABLE, OR A COMPUTER PROGRAM LISTING COMPACT DISK APPENDIX

[0003] Not applicable

BACKGROUND OF THE INVENTION

[0004] Their exists the need for a non-traditional dart game where the playing surface can be changed into many different game scenarios and for such a game to be automatically scored by electronic sensors. Below is discussed patents that use means, other than the method described in this invention, to locate objects in a field.

[0005] The main method other inventions use to determine the presence and position of objects in a field is light beams. U.S. Pat. Nos. 3,807,858 4,097,800 and 2,630,222 disclose methods to detect the presence of objects moving through a field. More relative to the game of darts are U.S. Pat. Nos. 4,762,990 5,565,686 and 6,147,759 which determine not only presence but location coordinates by scanning light or laser light beams just above the surface where the object is located. The beams must scan a sufficient distance above the target surface to avoid irregularities in the surface. The drawback of this method is that it assumes the dart is exactly perpendicular to the board surface. Because the coordinate provided by the light beam does not disclose the angle that the dart enters the board, the actual entry point of the tip of the dart is not known. Therefore, if we assume that a dart can manifest itself in a range of angles between ~45 degrees and +45 degrees (where zero degrees is perpendicular to the board), then the system is only accurate to a tolerance of 2 times d, where “d” is the distance the light beams are positioned above the board. These systems are reasonably accurate in scoring a traditional dart board because they assume the presence of wires (or “spider”) on the board that partition it into target areas. Because these wires tend to guide darts into one area or another, they help overcome the inaccuracy of the scanning beams. But the wires are of such thickness that they bend readily, and a dart thrown with sufficient force can penetrate the board directly beneath a wire, simply bending it out the way. In fact, U.S. Pat. No. 5,565,686 states that “it may be necessary to embed the spider [wires] of the dart board” in order to avoid these errors. The manufacture of such a board would be difficult, if not impossible. And embedding the wires would cause many more darts to bounce out of the board when hitting a wire.

[0006] There are 2 other patented means for locating darts or objects in a field that are relevant. U.S. Pat. No. 6,089,571 and U.S. Pat. No. 6,155,570 use a method that partitions the board according to its traditional wire bound-

aries into blocks which are depressed by thrown darts, completing an electronic circuit. U.S. Pat. No. 6,715,760 and U.S. Pat. No. 6,155,570 use graphite or electrically resistive ink to coat the board. Steel tipped darts complete electronic circuits correspondingly. These methods can lead to high error rate. For example, system that use target blocks must be manufactured with wide inflexible partitions instead of the very thin spider. This is done because neighboring target blocks could both register a “hit” if a dart struck directly down on a thin spider with sufficient force. The thicker spider deflects the dart’s energy into one target block of another. Similarly, ink or any electrically resistive substance will incur gradual wear and tear and must be periodically repaired. In addition to these problems, neither of these methods can be used in non traditional dart games where the game targets must be flexibly changed by the software.

BRIEF SUMMARY OF THE INVENTION

[0007] This invention describes an electronic amusement game where sensors locate the position of darts thrown by participants into a target board. The target board is not a traditional dart board but an uncolored dart board onto which is projected game images by a front projection monitor. The game locates the darts through the use of digital cameras that capture 2 dimensional images of the dart’s profile to establish coordinates. The software conducts game progress by incorporating the thrown dart’s position into the game itself. Any manner of game can be projected, including traditional dart games.

[0008] Using profile images of the projectile, the shape of which being analyzed by software, is the best possible method for locating the entry point of the dart into the target surface. This method overcomes the limitations of the systems discussed previously. With regard to surface irregularities, there is not the interference problem associated with light beam scanning systems. With regard to the system employing blocks which are depressed by the force of the dart and the systems that use electrically resistive ink or graphite on the surface, the system discussed here completely overcomes the limitations listed above. In addition, the system described in this patent can flexibly locate darts in any pattern of targets. Every other system has fixed targets.

BRIEF DESCRIPTION OF THE SEVERAL VIEWS OF THE DRAWING

[0009] FIG. 1 depicts the entire apparatus

[0010] FIG. 2 depicts an image of the playing surface taken by 40

[0011] FIG. 3 depicts an image of the playing surface taken by 30

[0012] FIG. 4 depicts a portion of an image from one of the cameras that contains a dart

[0013] FIG. 5 depicts the first step of analysis of FIG. 4 by the software

[0014] FIG. 6 depicts the second step of analysis of FIG. 4 by the software

[0015] FIG. 7 depicts a portion of an image from one of the cameras that contains a dart

[0016] FIG. 8 depicts the first step of analysis of FIG. 7 by the software
FIG. 9 depicts the second step of analysis of FIG. 7 by the software.

DETAILED DESCRIPTION OF THE INVENTION

Referring to FIG. 1, the game apparatus is constructed as follows. 20 is a sisal fiber dartboard that is white in color. 30 and 40 are identical digital cameras which obtain profile images of darts lodged into 20. 50 and 60 serve as uniformly colored backgrounds in the images taken by 30 and 40. 10 is the substrate to which each of these components are mounted. 70 is the housing for computer components and the substrate for mounting 80 and 90. 80 is the means by which players interface with the game controls. It consists of buttons and a video monitor in order to make selections regarding game play. 90 is the projection monitor that projects the game image onto 20. 100 is a dart lodged into 20. 110 is a toe line (or “toe”) that indicates where players place their forward-most foot when throwing darts. The following are crucial measurements for locating the components relative to one another. 10 is mounted perpendicular to the floor (preferably on a wall) such that the center of 20 is 5 feet 8 inches above a level floor. In order to locate 70 (and its attached components) a plumb bob is attached to the front surface of 20 and allowed to touch the floor. From this point, 70 must be positioned such that the furthest side of 110 is 7 feet 9 and one quarter inches away.

Two cameras (30 and 40) are sufficient to establish the coordinates of a dart. 30 determines the x axis coordinate, and 40 determines the y axis coordinate. FIGS. 2 and 3 illustrate potential images taken by 40 (in FIG. 2) and 30 (in FIG. 3). The height of the images, at a minimum, is from the surface of the board to approximately one inch above the board. The width of the images encompasses, at a minimum, the entire width of the target surface. FIG. 4 depicts an image, taken by either 30 or 40, of a dart lodged perpendicularly into the board. Software will ignore the lowest part of this image, due to irregularities in the surface of the board. Because all darts have a symmetrical cross-section and are linear, the software can locate its entry point into the board even though the lower part of the image where the entry point occurs is not considered. FIG. 5 depicts the information in FIG. 4 that is considered for analysis. Distance “a” is approximately 1/6 of an inch but can be any distance depending on the quality of the target surface. Distance “b” is approximately 1/2 of one inch in order to get a large sample size of the dart’s linear structure. Starting at the upper portion of this image, the software analyzes horizontal slivers of the image. These slivers are the entire width of the playing surface and have a height that is as small as possible given the resolution of the camera. Each sliver is composed entirely of background except for the contrasting presence of a dart. The dart does not occupy merely a point in the sliver, but many points according to its width. The software identifies the center of this width, and this is the first point that it uses in constructing a line of points continuing with progressively lower slivers of the image. The line constructed out of the partial dart image in FIG. 5 is shown in FIG. 6. The software halts the construction of this line when it gets to the point where surface irregularities could occur (distance “a”). Because the distance from this height to the surface is known, the intersection of the constructed line and the surface can be computed. This is shown in FIG. 6 by the dashed line extension.

While a perpendicular dart is easily located by the scanning light beam systems mentioned earlier, FIGS. 7, 8 and 9 show a more common dart orientation that create errors in scanning light beam systems. A note should be made about a difference between this angled dart and the perpendicular dart in FIG. 4. In FIG. 7 it is shown that the angled dart penetrated the board to a lesser extent than the dart in FIG. 4. This will always be true of angled darts. In order for a dart to attain an angled penetration, one of two things must occur. Either the dart must be thrown gently such that travels on a high arc and that the dart’s center of mass pushes it into the board in this downward angle. Or the dart could be thrown more firmly, so that it takes more of a straight-line path to the board, but the dart’s center of mass is not directly behind it’s tip so that its inertia is depleted. In either case penetration is shallow. When the software constructs a line in analysis of an angled dart, this line will be non-linear where the dart changes diameter. This is shown in FIG. 9. But because the dart achieves shallow penetration, the uniform, linear tip of the dart is exposed enough to create a sufficiently long segment of the line within distance “b” that is linear. The non-linear portion of the line segment within distance “b” is ignored, and the dashed line extension is constructed accurately.

Although this invention is described in a dart game embodiment, the broad inventive concept is applicable to other types of surfaces and objects within fields. Those skilled in the art could make changes in the embodiment without departing from the spirit and scope of the present invention. Therefore, the invention is not limited to the embodiment described, but instead, covers these potential modifications.

What is claimed is:

1. A game apparatus comprising:
   (a) An uncolored target board suitable for receiving thrown darts
   (b) At least 2 digital cameras that capture profile images of darts lodged into the target board
   (c) A projection monitor that projects video game images onto the uncolored dartboard
   (d) Computer hardware
   (e) A console allowing players to interact with the game
2. Game software utilized by the computer hardware in claim 1 which produces various video game images that provide targets for thrown darts
3. Dart locating software utilized by the computer hardware in claim 1 that locates the precise entry point of darts by:
   (a) Cropping the digital images of the dart’s profile produced by the digital cameras in order to ignore image data near the board surface
   (b) Separating these images into horizontal slivers and finding the center point of each sliver
   (c) Assembling the center points of these slivers in sequence and ignoring the portion(s) of the sequence that are not linear
   (d) Constructing an extension to this linear arrangement of center points that intersects with the board surface