

DART GAME APPARATUS, DART SPEED DISPLAY METHOD, AND PROGRAM

Cross-Reference to Related Application

[0001] This application is based on Japanese Patent Application No. 2017-145898 filed on July 27, 2017, the contents of which are incorporated herein by reference.

Technical Field

[0002] The present invention relates to a dart game apparatus, a dart speed display method, and a program.

Background Art

[0003] In the past, a dart game apparatus in which players compete for scores according to the positions hit by darts is known (for example, see Patent Document 1). In the conventional dart game apparatus, since scores are calculated automatically according to the positions hit by darts, players can concentrate on the game without counting the points themselves.

Citation List

Patent Document

[0004] Patent Document 1: Patent Publication JP-B-4682986

Summary

Technical Problem

[0005] In a dart game, maintaining an arm swinging method, a darts throwing speed, or the like constant is the trick to hit darts at a target area. If players know the speed of darts thrown by themselves, the players can determine by themselves whether the darts throwing method is appropriate and can enjoy a dart game more than ever.

However, there was no dart game apparatus having a function of displaying the speed of darts thrown by players.

Therefore, an object of the present invention is to provide a dart game apparatus, a dart speed display method, and a program capable of displaying the speed of darts.

Solution to Problem

[0006] A dart game apparatus according to an aspect of the present invention is a dart game apparatus that provides a dart game in which players throw darts toward a dart board, including: a speed sensor provided in the dart board to output speed data indicating a measured speed of an object; a speed detection unit that detects the speed of the dart that the player throws toward the dart board using the speed data received from the speed sensor; and a display unit that displays the speed of the dart detected by the speed detection unit.

Advantageous Effects of Invention

[0007] According to the present invention, it is possible to provide a dart game apparatus, a dart speed display method, and a program capable of displaying the speed of darts.

Brief Description of Drawings

[0008] Fig. 1 is an external perspective view of a dart game apparatus according to an embodiment.

Fig. 2 is a front view of a dart board.

Fig. 3 is a diagram illustrating an example of a hardware configuration of the dart game apparatus.

Fig. 4 is a diagram illustrating an example of a functional block configuration of the dart game apparatus.

Fig. 5 is a diagram for describing a processing procedure of detecting the speed of darts.

Fig. 6 is a diagram illustrating an angular difference between an emission direction of microwaves and a moving direction of darts.

Description of Embodiments

[0009] Preferred embedded display of the present invention will be described with reference to the accompanying drawings. In the drawings, components denoted by the same reference numerals have the same or similar configuration.

[0010] <Entire Configuration>

Fig. 1 is an external perspective view of a dart game apparatus according to an embodiment. As illustrated in Fig. 1, a dart game apparatus 10 is formed in a vertical rectangular parallelepiped shape, for example. The dart game apparatus 10 provides a dart game in which one player throws three darts continuously in one round or the like to players, for example. The darts are not particularly limited to soft darts or hard darts.

[0011] The dart game apparatus 10 includes a dart board 12 and a display device 14. The dart board 12 is disposed on a front surface of the dart game apparatus 10 approximately at a visual line position in a standing posture of a player. The display device 14 displays a still image or a moving image.

[0012] A coin slot, a mode select switch, and the like are provided in the front surface of the dart game apparatus 10. A player inserts a charge into the coin slot, presses the mode select switch to select a game mode, and plays a dart game. In this dart

game, a player stands at a predetermined position in front of the dart game apparatus 10 and throws darts at a predetermined target on the dart board 12. The tip of a dart having reached the dart board 12 is stuck in the dart board 12, a coordinate position of the stuck dart is detected, and a score corresponding to the stuck position is displayed on the display device 14.

[0013] Fig. 2 is a front view of the dart board 12. A speed sensor 16 is attached to a top-left corner of the dart board 12 to measure the speed of a surrounding object and outputs speed data indicating the measured speed of the object. The attachment position of the speed sensor 16 is not limited to the position illustrated in Fig. 2. The speed sensor 16 may be attached to an arbitrary position as long as it is possible to measure the speed of darts.

[0014] A disk surface 18 is divided into a plurality of segments associated with different scores, and a segment sensor that detects which segment of the plurality of segments has been pressed is attached to the rear surface of the disk surface 18. The segment sensor is made up of a group of switches provided in respective segments, and a switch corresponding to a segment stuck by a dart is pressed by the force applied when the dart is stuck in the segment whereby the segment stuck by the dart is specified.

[0015] An impact sensor that detects an impact applied to the dart board 12 is attached to the rear surface of the dart board 12. The impact sensor is used for detecting that a dart has reached any one of the positions of the entire dart board 12, for example. Although the segment sensor cannot detect a dart unless the dart reaches the disk surface 18, the impact sensor can detect a dart even when the dart reaches a position shifted from the disk surface 18.

[0016] The dart game apparatus 10 may include a position detection sensor including a plurality of light sources 24A attached to the circumference of the dart board 12, a plurality of optical sensors 24B that detects light intensity of the light emitted from the light sources 24A, and a processing device that calculates the position stuck by a dart, of the disk surface 18 (this is not essential, and the same hereinbelow). Due to the position detection sensor, the dart game apparatus 10 can determine the position at which a dart is stuck in the disk surface 18 more accurately than a segment.

[0017] <Hardware Configuration>

Fig. 3 is a diagram illustrating an example of a hardware configuration of the dart game apparatus 10. The dart game apparatus 10 includes the display device 14, the speed sensor 16, the impact sensor 20, the segment sensor 22, a light source 24A, an optical sensor 24B, an operating device 26, and a control device 30. The control device 30 includes a CPU 32 that controls an entire system and a memory 34.

[0018] When the power of the dart game apparatus 10 is turned on, the CPU 32 reads a game program according to a boot program stored in the memory 34 and outputs a game screen to the display device 14. A player enjoys a desired game mode according to a coin insertion signal from the operating device 26 and an input signal from the select switch and a start switch.

[0019] <Functional Block Configuration>

Fig. 4 is a diagram illustrating an example of a functional block configuration of the dart game apparatus 10. The dart game apparatus 10 includes a game execution unit 100, a speed detection unit 102, a display unit 104, and a foul detection unit 106. The game execution unit 100, the speed detection unit 102, the display unit 104, and the foul detection unit 106 can be realized by the process that the CPU

32 executes according to the program stored in the memory 34. The program can be stored in a recording medium. The recording medium storing the program therein may be a computer-readable non-transitory recording medium. The non-transitory recording medium is not particularly limited and may be a recording medium such as a USB memory or a CD-ROM, for example.

[0020] The game execution unit 100 has a function of performing various processes for executing a dart game. Various processes include, for example, progress of a game mode selected by a player, determination of a dart reaching the dart board 12, determination of a position of a dart stuck in the disk surface 18, calculation of scores, display of animation for rendering a dart game.

[0021] The game execution unit 100 determines that a timing at which the impact sensor 20 has detected an impact is the timing at which a dart has reached the dart board 12. The game execution unit 100 may determine that a timing at which the segment sensor 22 has detected pressing of any one of the plurality of segments included in the dart board 12 or a timing at which a dart having stuck in the disk surface 18 is notified of by a position detection sensor is the timing at which the dart has reached the dart board 12 regardless of whether the impact sensor 20 has detected an impact. The game execution unit 100 notifies the speed detection unit 102 of a determination result that the dart has reached the dart board 12 when it is determined that the dart has reached the dart board 12.

[0022] The speed detection unit 102 has a function of detecting the speed of a dart that a player throws toward the dart board 12 using the speed data indicating the speed of an object, output from the speed sensor 16. Here, the speed sensor 16 included in the dart game apparatus 10 may be a sensor that outputs the speed data indicating the speed of an object detected by the speed sensor 16 in a discrete

manner. In this case, the speed detection unit 102 may detect the speed data received from the speed sensor 16 in a period (hereinafter referred to as a “predetermined determination period”) between the timing at which the game execution unit 100 has determined that the dart has reached the dart board 12 and a timing predetermined period before the timing as the speed of a dart.

[0023] The display unit 104 has a function of displaying the speed of a dart detected by the speed detection unit 102 on the display device 14.

[0024] The foul detection unit 106 has a function of determining whether a player has performed a foul play. Specifically, the foul detection unit 106 determines that a player has not performed a foul play when the game execution unit 100 determines that a dart has been stuck in the disk surface 18 and the speed of a dart has been detected by the speed detection unit 102. Moreover, the foul detection unit 106 determines that there is a possibility that a player has performed a foul play when the game execution unit 100 determines that a dart has been stuck in the disk surface 18 and the speed of a dart has not been detected by the speed detection unit 102. The foul play performed by a player is, for example, an action that a player causes the dart game apparatus 10 to make erroneous determination that the player has thrown a dart by pressing a segment by himself or herself even if the player has not actually thrown a dart. When the foul detection unit 106 determines that there is a possibility that a player has performed a foul play, the game execution unit 100 may not allow the score to be counted. When the number of times that the foul detection unit 106 determines that there is a possibility that a player has performed a foul play exceeds a predetermined number of times, the game execution unit 100 may determine that the player has performed a foul play and may not allow the score to be counted.

[0025] <Processing Procedure>

(Dart Speed Detection)

Next, a specific processing procedure performed by the dart game apparatus 10 will be described. The speed sensor 16 of the present embodiment is a Doppler sensor, for example, and is attached to the dart board 12 so that microwaves are emitted toward a space between a player and the dart game apparatus 10. The speed sensor 16 detects the speed of an object using a difference between the frequency of the emitted microwaves and the frequency of microwaves reflected from a moving object.

[0026] Fig. 5 is a diagram for describing a processing procedure of detecting the speed of a dart. The speed sensor 16 outputs the speed data indicating the speed of an object in a discrete manner as illustrated in Fig. 5. A vertical direction in Fig. 5 indicates a speed (km/h) and a horizontal direction indicates a time (t). P1 to P6 in Fig. 5 are the speed data output from the speed sensor 16 arranged in the order of the time at which the speed data was received by the speed detection unit 102.

[0027] Here, since the speed sensor 16 cannot determine whether the moving object is a dart, the speed data output from the speed sensor 16 includes the speed data detected in an operation of a player swinging an arm and the speed data detected when microwaves are reflected to a person walking around the dart game apparatus 10 in addition to the dart speed.

[0028] Therefore, the speed detection unit 102 may determine that the speed data received from the speed sensor 16 at a timing closest to the timing at which it is determined that a dart has reached the dart board 12 among one or more pieces of speed data received from the speed sensor 16 within a predetermined determination period is the speed data corresponding to the speed of a dart in order to appropriately

select the speed data corresponding to the speed of a dart among pieces of speed data received from the speed sensor 16.

[0029] Here, the predetermined determination period is a period from a timing (T1 in Fig. 5) at which the game execution unit 100 determines that a dart has reached the dart board 12 to a timing (T2 in Fig. 5) a predetermined period (for example, one second or 0.5 second) before the timing. In this way, since the speed detection unit 102 determines that the measurement data measured most recently after a dart reached the dart board 12 is the speed data corresponding to the speed of a dart, it is possible to prevent the speed data which is not related to the speed of a dart such as the speed data detected in an operation of a player swinging an arm from being erroneously determined to be the speed data corresponding to the speed of a dart and to detect the speed of a dart more accurately.

[0030] The speed sensor 16 may determine that the fastest speed data within a predetermined determination period is the speed data corresponding to the speed of a dart. In a store where the dart game apparatus 10 is placed, since it is generally expected that an object moving faster than the flying speed of a dart is not present, it is possible to prevent the speed data corresponding to an object other than a dart from being erroneously determined to be the speed data corresponding to the speed of a dart and to detect the speed of a dart more accurately.

[0031] Here, there may be a case in which the speed data output from the speed sensor 16 has not reached the speed detection unit 102 within a predetermined determination period due to some reasons and the speed detection unit 102 cannot detect the speed of a dart. In order to cope with such a case, when the speed data received from the speed sensor 16 within a predetermined determination period is not present, the speed detection unit 102 may determine that the speed data received

from the speed sensor 16 after the timing at which it is determined that the dart has reached the dart board 12 is the speed data corresponding to the speed of a dart. More specifically, when the speed data received from the speed sensor 16 within a predetermined determination period is not present, the speed detection unit 102 may determine that the speed data received from the speed sensor 16 in a period up to a timing (T3 in Fig. 5) a predetermined period elapsed from the timing (T1 in Fig. 5) at which it is determined that the dart has reached the dart board 12 is the speed data corresponding to the speed of the dart. Even if the speed data output from the speed sensor 16 has not reached the speed detection unit 102 because it was delayed due to some reasons, the speed detection unit 102 can detect the speed of the dart.

[0032](Dart Speed Correction)

The speed sensor 16 detects the speed of a dart using the Doppler effect. Here, when a speed is detected using the Doppler effect, and the emission direction of microwaves and the moving direction of a detection target object are not on the same axis, the speed of the object is detected to be low and a measurement error occurs.

[0033] Fig. 6 is a diagram illustrating an angular difference between the emission direction of microwaves and the moving direction of a dart. A1 indicates the position at which a player throws darts and B1 and B2 indicate the positions at which the darts are stuck in the disk surface 18. An orbit O1 indicates an example of an orbit of a dart until the dart is stuck at B1 after a player throws the dart from the position of A1, and an orbit O2 indicates an example of an orbit of a dart until the dart is stuck at B2 after a player throws the dart from the position of A1. Moreover, L1 indicates an example of a position at which it is expected that microwaves emitted from the speed

sensor 16 reach the dart and are reflected therefrom. When a dart flies along the orbit O1, an angular difference between the traveling direction of the microwaves and the moving direction of the dart is θ_1 . When a dart flies along the orbit O2, an angular difference between the traveling direction of the microwaves and the moving direction of the dart is θ_2 . In the case of Fig. 6, since $\theta_1 < \theta_2$, when the dart flies along the orbit O2, a measurement error of the dart speed increases as compared to when the dart flies along the orbit O1.

[0034] Here, the orbit of a dart until the dart is stuck in the disk surface 18 after the dart is thrown changes in various ways depending on the position at which a player throws the dart, the speed of the dart, and the position at which the dart is stuck in the disk surface 18. However, when the position at which a player throws a dart is fixedly determined, the orbit of the dart can be estimated from the speed of the dart and the position at which the dart is stuck in the disk surface 18. Moreover, the angle between the emission direction of microwaves and the moving direction of a detection target dart can be estimated by fixedly determining the position at which it is estimated that microwaves are reflected on the orbit of the dart in advance.

[0035] Therefore, in the present embodiment, in order to simplify a process of correcting a dart speed, the position (A1 in Fig. 6) at which a player throws a dart and a position (L1 in Fig. 6) at which it is estimated that microwaves reach on the orbit of the dart may be fixed. In this state, the speed detection unit 102 may calculate an angular difference between the traveling direction of microwaves and the moving direction of a dart on the basis of the speed data determined to be the speed data corresponding to the speed of the dart among the pieces of speed data received from the speed sensor 16 and the position at which the dart is stuck in the disk surface 18 and correct the value of the speed data using the calculated angular difference to

thereby detect the corrected dart speed. When the segment sensor 22 detects the position at which the dart is stuck in the disk surface 18, the speed detection unit 102 may regard that the position at which the dart is stuck in the disk surface 18 is the center of a segment. Moreover, when a position detection sensor detects the position at which the dart is stuck in the disk surface 18, the speed detection unit 102 may regard that the position detected by the position detection sensor itself is the position at which the dart is stuck in the disk surface 18.

[0036]As another method, a table (a speed correction table) in which a dart speed, the position at which the dart is stuck in the disk surface 18, and a change amount of the dart speed occurring due to an angular difference between the traveling direction of microwaves and the moving direction of the dart are correlated with each other may be stored in advance in the memory 34 or the like. Moreover, the speed detection unit 102 may search the table using the speed data received from the speed sensor 16 and the position at which the dart is stuck in the disk surface 18 as keys to acquire a change amount of the dart speed and multiply the acquired change amount by the speed data acquired from the speed sensor 16 to thereby detect the dart speed. In the table, the position at which a dart is stuck in the disk surface 18 may be divided in respective segments of the disk surface 18 and may be divided in more finer units than segments.

[0037](Modification)

In the present embodiment, a speed sensor which uses a stereo camera attached to the dart board 12 may be used as the speed sensor 16 instead of the Doppler sensor. The speed sensor which uses a stereo camera measures the distance between the dart board 12 and the dart by photographing the dart flying toward the dart board 12 using two cameras, for example, and calculates the speed

of the dart on the basis of the moving time and the moving distance of the dart obtained from the measurement results of a plurality of number of times.

[0038] The embodiments described above are presented to facilitate understanding of the present invention and are not intended to limit the interpretation of the present invention. The respective elements included in the embodiments and the arrangement, materials, conditions, shapes, sizes, and the like of the elements are not limited to those illustrated but may be changed appropriately. Components illustrated in different embodiments may be partially substituted or combined with each other.

[0039] In the present invention, "unit" does not mean simply a physical means but includes a case in which the function of the "unit" is realized by software. The function of one "unit" or device may be realized by two or more physical means or devices, and the functions of two or more "units" and devices may be realized by one physical means or device.

Reference Signs List

[0040] 10: Dart game apparatus

- 12 Dart board
- 14 Display device
- 16 Speed sensor
- 18 Disk surface
- 20 Impact sensor
- 22 Segment sensor
- 24A Light source

24B	Optical sensor
26	Operating device
30	Control device
32	CPU
34	Memory
100	Game execution unit
102	Speed detection unit
104	Display unit
106	Foul detection unit

What is claimed is:

1. A dart game apparatus that provides a dart game in which players throw darts toward a dart board, comprising:

a speed sensor provided in the dart board to output speed data indicating a measured speed of an object;

a speed detection unit that detects the speed of the dart that the player throws toward the dart board using the speed data received from the speed sensor; and

a display unit that displays the speed of the dart detected by the speed detection unit.

2. The dart game apparatus according to claim 1, wherein

the speed sensor outputs speed data whenever detecting the speed of the dart, and

the speed detection unit determines that the speed data received from the speed sensor within a predetermined determination period which is a period from a timing at which it is determined that the dart has reached the dart board to a timing a predetermined period before the timing is the speed data corresponding to the speed of the dart.

3. The dart game apparatus according to claim 2, wherein

the speed detection unit determines the speed data received from the speed sensor at a timing closest to the timing at which it is determined that the dart has reached the dart board among one or more pieces of speed data received from the

speed sensor within the predetermined determination period is the speed data corresponding to the speed of the dart.

4. The dart game apparatus according to claim 3, wherein

the speed detection unit determines that the speed data received from the speed sensor after a timing at which it is determined that the dart has reached the dart board when the speed data received from the speed sensor within the predetermined determination period is not present is the speed data corresponding to the speed of the dart.

5. The dart game apparatus according to any one of claims 2 to 4, further comprising:

an impact sensor that detects an impact applied to the dart board, wherein

the speed detection unit regards that a timing at which the impact sensor has detected an impact is the timing at which the dart has reached the dart board.

6. The dart game apparatus according to any one of claims 1 to 5, wherein

the speed detection unit detects the speed of the dart by correcting the speed data on the basis of the speed data received from the speed sensor and the position at which the dart reached the dart board.

7. The dart game apparatus according to any one of claims 1 to 6, further comprising:

a foul detection unit that determines whether the player has thrown a dart properly, wherein

the foul detection unit determines that the player has not performed a foul play when it is determined that the dart has been stuck in a disk surface of the dart board and the speed of the dart is detected by the speed detection unit, and

the foul detection unit determines that there is a possibility that the player has performed a foul play when it is determined that the dart has been stuck in the disk surface of the dart board and the speed of the dart is not detected by the speed detection unit.

8. A method of displaying dart speed executed by a dart game apparatus that provides a dart game in which players throw darts toward a dart board, which comprises the steps of:

detecting a speed of the dart that the player throws toward the dart board using speed data received from a speed sensor provided in the dart board to output speed data indicating a measured speed of an object; and

displaying the detected speed of the dart.

9. A program that provides a dart game in which players throw darts toward a dart board, the program causing a computer to execute the steps of:

detecting a speed of the dart that the player throws toward the dart board using speed data received from a speed sensor provided in the dart board to output speed data indicating a measured speed of an object; and

displaying the detected speed of the dart.