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(54) **SELECTION SUPPORT APPARATUS, SELECTION SUPPORT SYSTEM, AND SELECTION SUPPORT METHOD**

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(57) **ABSTRACT**

A selection support apparatus includes an obtaining unit obtaining a measurement result of a golf swing movement of a golfer, and a selection unit selecting, from a plurality of types of club characteristics of a golf club, a club characteristic suitable for the golfer based on the measurement result. The selection unit selects a club characteristic suitable for the golfer based on machine learning results of teacher data indicating a club characteristic suitable for a golf swing movement of each tester of a plurality of testers.

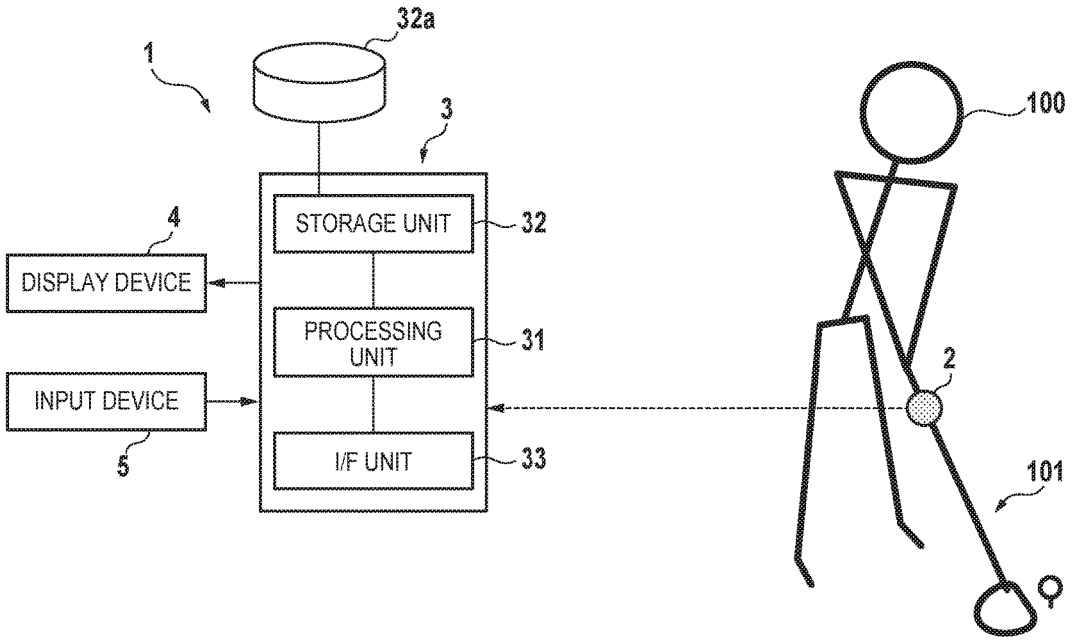


FIG. 1

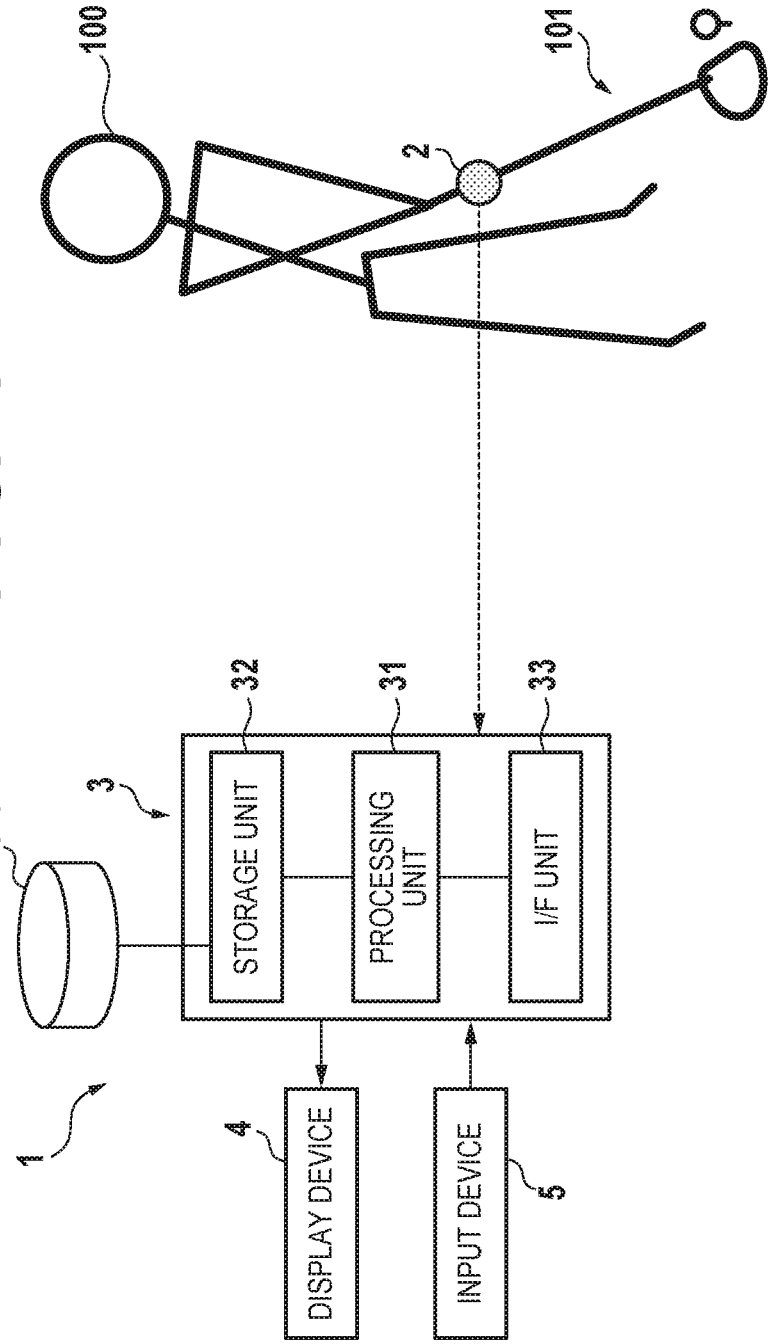

100
101
2
32
31
33
3
32a
STORAGE UNIT
PROCESSING UNIT
I/F UNIT
1
4
DISPLAY DEVICE
INPUT DEVICE
5

FIG. 2

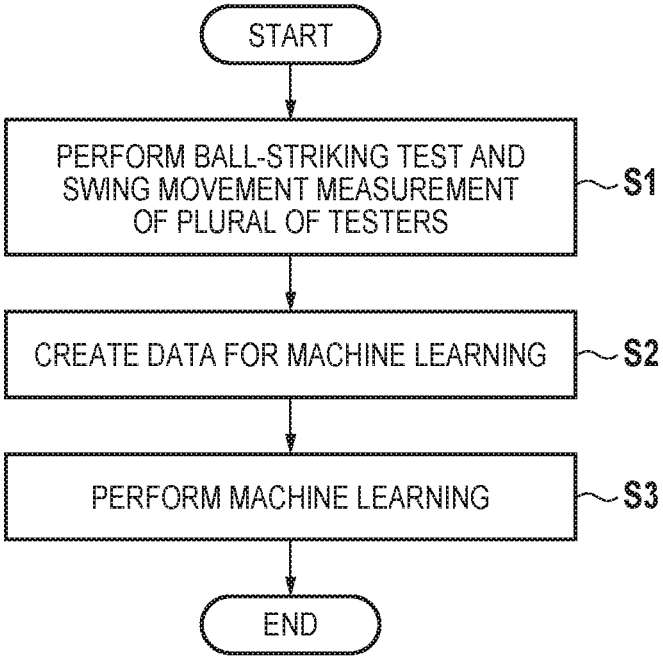

START
PERFORM BALL-STRIKING TEST AND SWING MOVEMENT MEASUREMENT OF PLURAL OF TESTERS
S1
CREATE DATA FOR MACHINE LEARNING
S2
PERFORM MACHINE LEARNING
S3
END

FIG. 3A

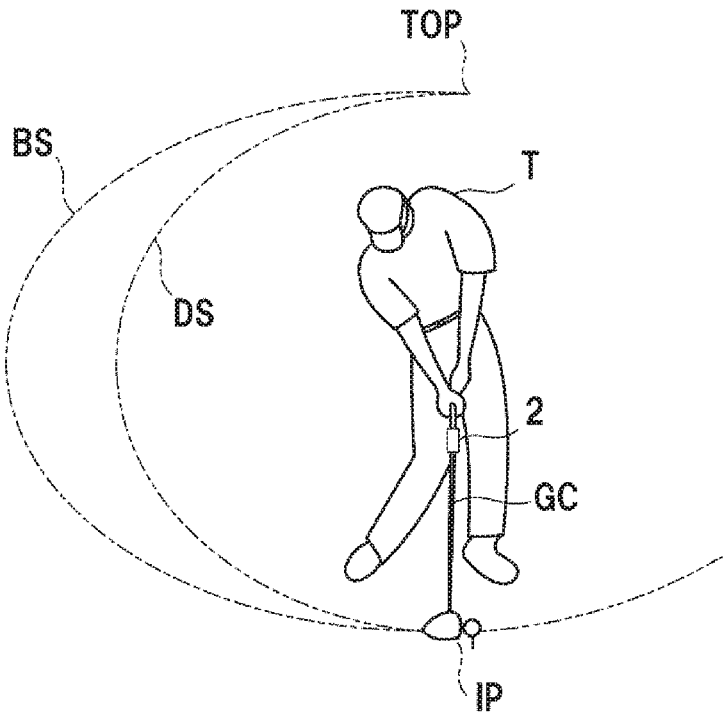


FIG. 3B

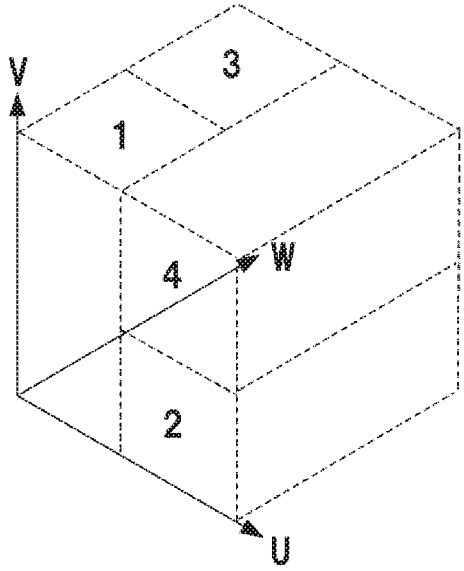


FIG. 4

D0

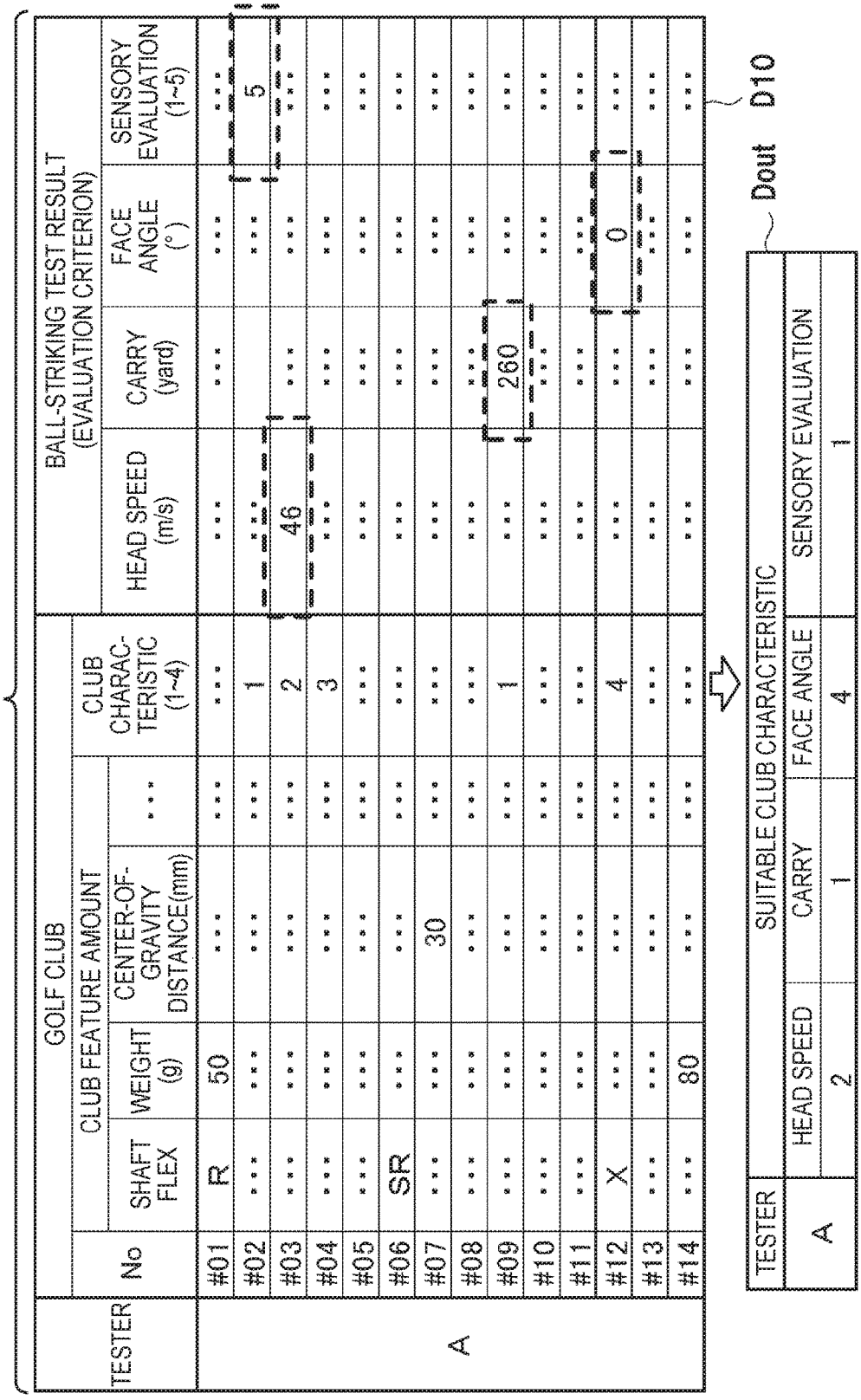
TESTER	TIME (sec)	ACCELERATION (m/s^2)			ANGULAR VELOCITY (rad/sec)		
		X AXIS	Y AXIS	Z AXIS	X AXIS	Y AXIS	Z AXIS
A	0.000	...	...	...	...	...	...
	0.001	6.13	−0.59	7.80	−0.01	0.01	−0.18
	0.002	...	...	...	...	...	...
	0.003	...	...	...	...	...	...
	...	...	...	...	...	...	...
	0.968	−4.73	...	...	...	...	...
	...	...	...	...	...	...	...
	1.364	31.96	...	...	...	...	...
	...	...	...	...	...	...	...
	1.600	...	...	...	...	...	...

D1

Din

TESTER	No.	ACCELERATION (m/s^2)			ANGULAR VELOCITY (rad/sec)		
		X AXIS	Y AXIS	Z AXIS	X AXIS	Y AXIS	Z AXIS
A	0001	−4.73	...	...	...	...	...
	0002	...	...	...	...	...	...
	...	...	...	...	...	...	...
	1000	31.96	...	...	...	...	...

FIG. 5



TESTER	GOLF CLUB						BALL-STRIKING TEST RESULT (EVALUATION CRITERION)			
		CLUB FEATURE AMOUNT				CLUB CHARACTERISTIC (1~4)	HEAD SPEED (m/s)	CARRY (yard)	FACE ANGLE (°)	SENSORY EVALUATION (1~5)
	No	SHAFT FLEX	WEIGHT (g)	CENTER-OF-GRAVITY DISTANCE(mm)	...					
A	#01	R	50	***	***	***	***	***	***	***
	#02	***	***	***	***	1	***		***	5
	#03	***	***	***	***	2	46	***	***	***
	#04	***	***	***	***	3	***	***	***	***
	#05	***	***	***	***	***	***	***	***	***
	#06	SR	***	***	***	***	***	***	***	***
	#07	***	***	30	***	***	***	***	***	***
	#08	***	***	***	***	***	***	***	***	***
	#09	***	***	***	***	1	***	260	***	***
	#10	***	***	***	***	***	***	***	***	***
	#11	***	***	***	***	***	***	***	***	***
	#12	X	***	***	***	4	***	***	0	***
	#13	***	***	***	***	***	***	***	***	***
	#14	***	80	***	***	***	***	***	***	***

Dout D10

TESTER	SUITABLE CLUB CHARACTERISTIC			
	HEAD SPEED	CARRY	FACE ANGLE	SENSORY EVALUATION
A	2	1	4	1

FIG. 6

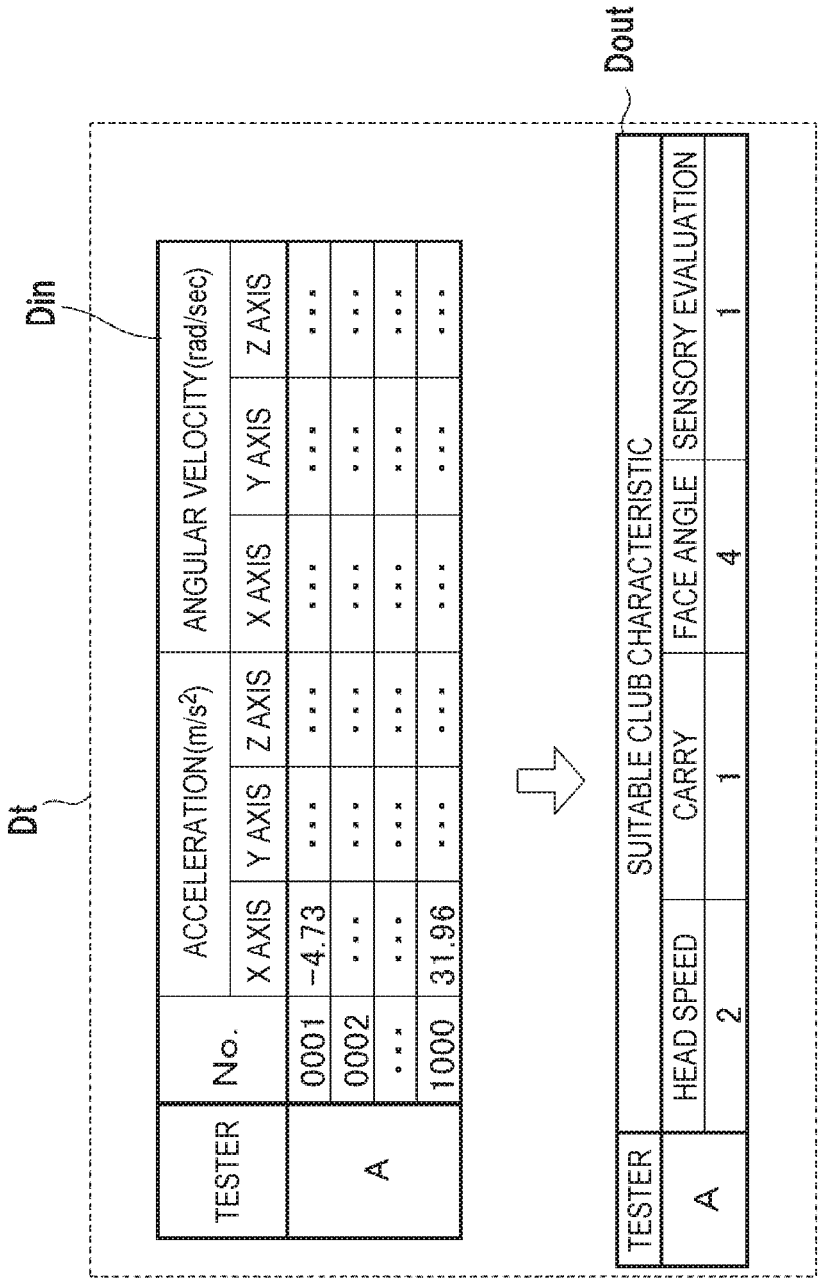

Dt
Din
TESTER
No.
ACCELERATION(m/s²)
ANGULAR VELOCITY(rad/sec)
X AXIS
Y AXIS
Z AXIS
X AXIS
Y AXIS
Z AXIS
A
0001
−4.73
...
...
...
...
...
0002
...
...
...
...
...
...
...
...
...
...
...
...
...
1000
31.96
...
...
...
...
...
Dout
TESTER
SUITABLE CLUB CHARACTERISTIC
HEAD SPEED
CARRY
FACE ANGLE
SENSORY EVALUATION
A
2
1
4
1

FIG. 7

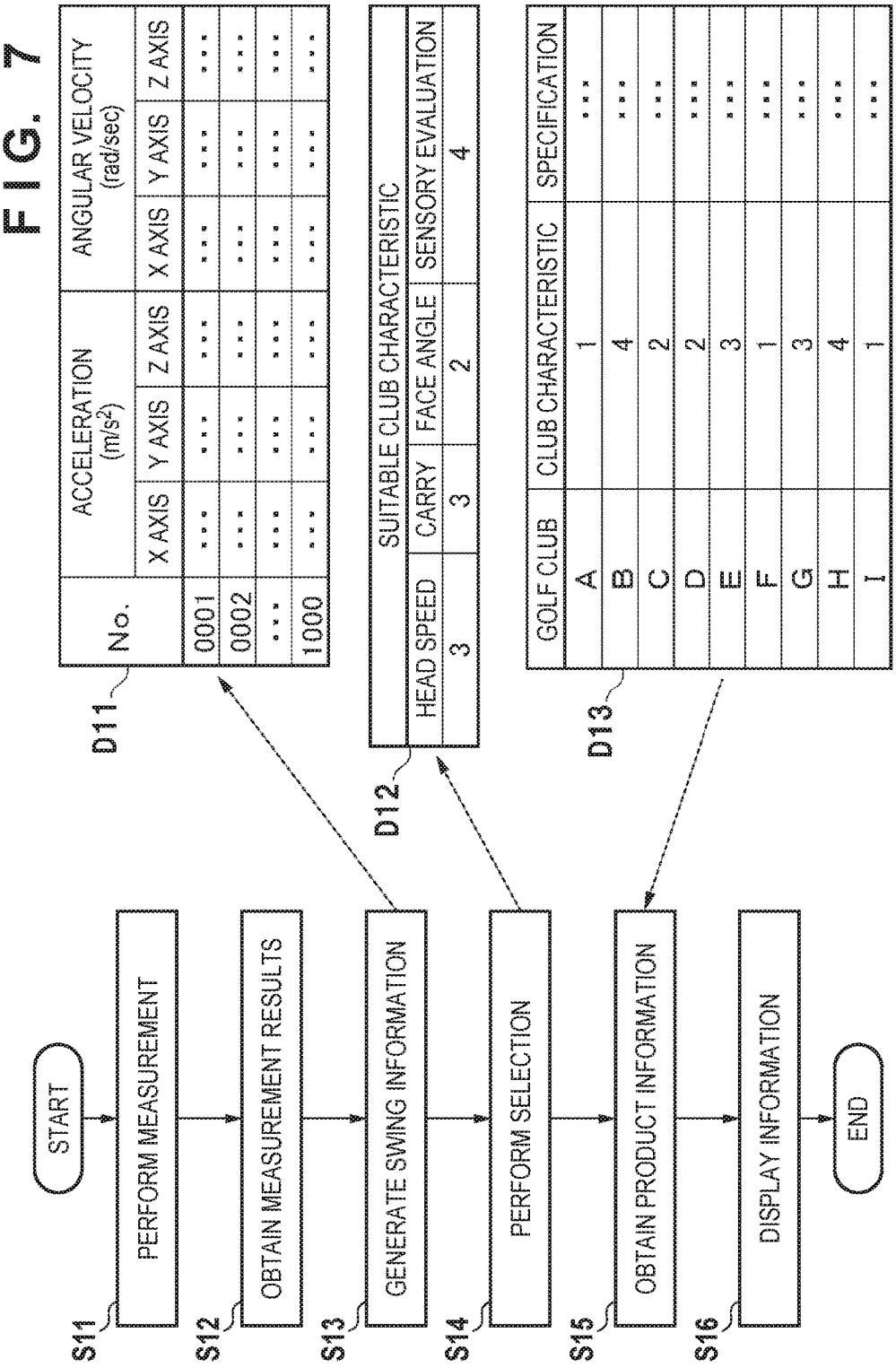
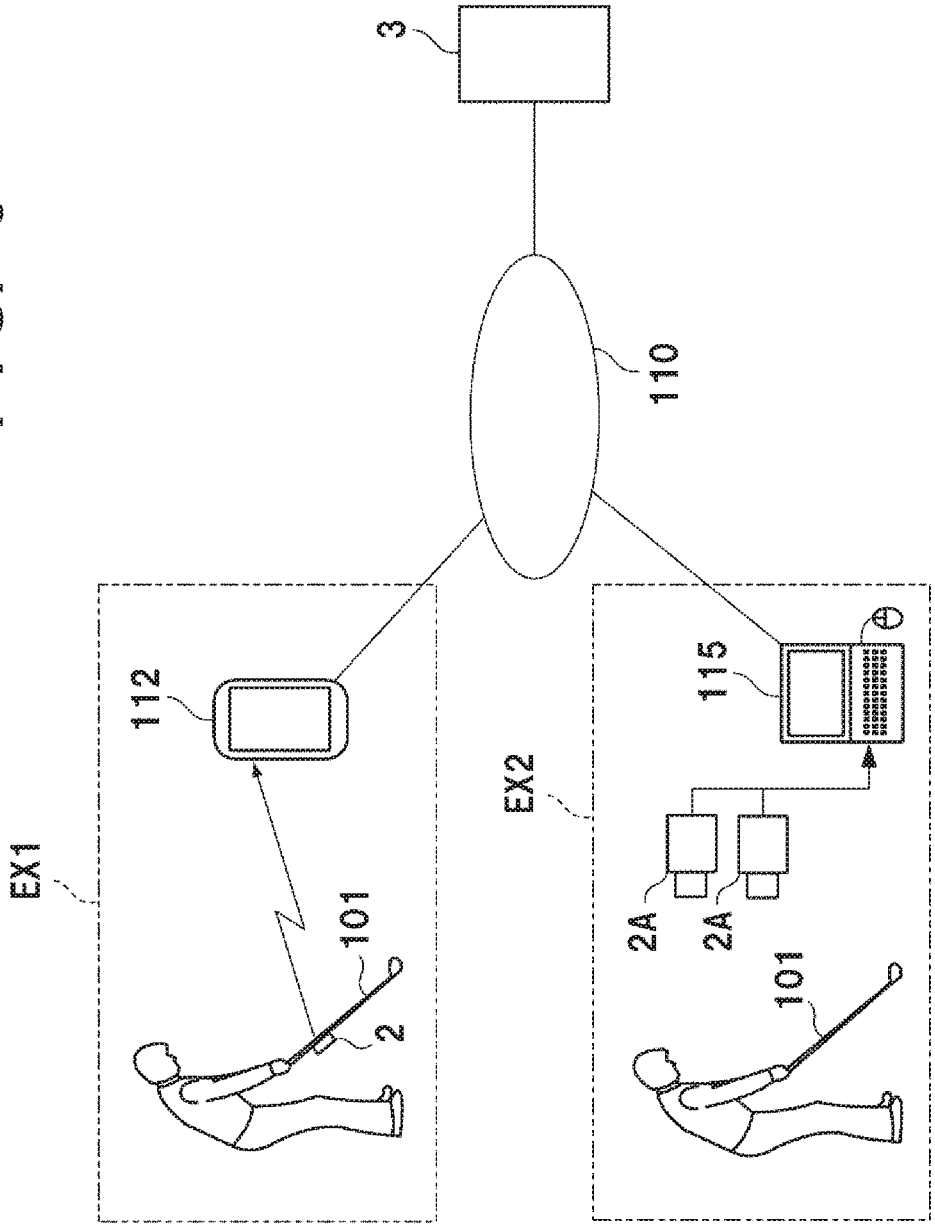

D11
No.
ACCELERATION (m/s²)
X AXIS
Y AXIS
Z AXIS
ANGULAR VELOCITY (rad/sec)
X AXIS
Y AXIS
Z AXIS
0001
0002
1000
D12
SUITABLE CLUB CHARACTERISTIC
HEAD SPEED
CARRY
FACE ANGLE
SENSORY EVALUATION
3
3
2
4
D13
GOLF CLUB
CLUB CHARACTERISTIC
SPECIFICATION
A
B
C
D
E
F
G
H
I
START
PERFORM MEASUREMENT
OBTAIN MEASUREMENT RESULTS
GENERATE SWING INFORMATION
PERFORM SELECTION
OBTAIN PRODUCT INFORMATION
DISPLAY INFORMATION
END
S11
S12
S13
S14
S15
S16

FIG. 8



SELECTION SUPPORT APPARATUS, SELECTION SUPPORT SYSTEM, AND SELECTION SUPPORT METHOD

BACKGROUND OF THE INVENTION

Field of the Invention

[0001] The present invention relates to a technique of supporting the golf club selection of a golfer.

Description of the Related Art

[0002] There have been proposed techniques of analyzing a golfer's swing (for example, Japanese Patent Laid-Open Nos. 2014-530047, 2014-500078, 2013-165808, 2011-502602, 2008-523384, 04-117972 and 01-125628). Such analyzing techniques can be useful in helping the golfer select a golf club that is suitable for him/her.

[0003] As a method of selecting a golf club that is suitable for a golfer, there is a method of classifying a golf swing by extracting a specific feature of the golf swing. For example, a classification by the angle of a swing track can be performed. However, the golf swing of a human is complex. Hence, even if some golfers have a specific feature in common, it does not mean that a golf club of the same characteristic will be suitable for all of these golfers.

SUMMARY OF THE INVENTION

[0004] It is an object of the present invention to provide a selection support technique characterized in determining club characteristics suitable for a golfer.

[0005] According to one aspect of the present invention, there is provided a selection support apparatus comprising: an obtaining unit configured to obtain a measurement result of a golf swing movement of a golfer; and a selection unit configured to select, from a plurality of types of club characteristics of a golf club, a club characteristic suitable for the golfer based on the measurement result, wherein the selection unit selects a club characteristic suitable for the golfer based on machine learning results of teacher data indicating a club characteristic suitable for a golf swing movement of each tester of a plurality of testers.

[0006] According to another aspect of the present invention, there is provided a selection support system comprising: a measurement device configured to measure a golf swing movement of a golfer; and an information processing apparatus configured to select, from a plurality of types of club characteristics of a golf club, a club characteristic suitable for the golfer based on a measurement result of the measurement device, wherein the information processing apparatus selects a club characteristic suitable for the golfer based on machine learning results of teacher data indicating a club characteristic suitable for a golf swing movement of each tester of a plurality of testers.

[0007] According to still another aspect of the present invention, there is provided a selection support method comprising: measuring a golf swing movement of a golfer; and selecting, from a plurality of types of club characteristics of a golf club, a club characteristic suitable for the golfer based on the measurement result of the measurement, wherein a club characteristic suitable for the golfer is selected in the selecting based on machine learning results of teacher data indicating a club characteristic suitable for a golf swing movement of each tester of a plurality of testers.

[0008] Further features of the present invention will become apparent from the following description of exemplary embodiments (with reference to the attached drawings).

BRIEF DESCRIPTION OF THE DRAWINGS

[0009] FIG. **1** is a schematic view of a selection support system according to one embodiment of the present invention;

[0010] FIG. **2** is a flowchart showing a procedure to make an artificial intelligence perform learning;

[0011] FIG. **3**A is an explanatory view of a swing movement range used for teacher data and the like;

[0012] FIG. **3**B is a schematic view showing classification examples of club characteristics;

[0013] FIG. **4** is a view showing examples of swing movement measurement data and swing information;

[0014] FIG. **5** is a view showing examples of ball-striking test results and suitable club information;

[0015] FIG. **6** is a view showing an example of data used for machine learning;

[0016] FIG. **7** is a view showing a flowchart that shows an example of selection support processing and examples of information; and

[0017] FIG. **8** is a view showing another example of a selection support system.

DESCRIPTION OF THE EMBODIMENTS

[0018] <System Arrangement>

[0019] FIG. **1** is a schematic view of a selection support system **1** according to an embodiment of the present invention. The system **1** includes a measurement device **2**, an information processing apparatus **3**, a display device **4**, and an input device **5**.

[0020] The measurement device **2** is a device that measures the golf swing movement of a golfer **100**. In this embodiment, the measurement device **2** is a device that measures the behavior of a golf club **101**, is a device attached to the shaft (or the grip) of the golf club **101**, and includes an acceleration sensor and an angular velocity sensor. For example, TSND **121** of ATR-Promotions, Inc. or M-tracer of Seiko Epson Corporation can be used as the measurement device **2**. The time-series data of three-dimensional acceleration and the time-series data of three-dimensional angular velocity of the golf club **101** during a swing from are obtained from the detection results of the measurement device **2**.

[0021] In this embodiment, the information processing apparatus **3** is a computer that functions as a selection support apparatus that recommends a golf club suitable for the golfer **100**. In this embodiment, a driver is assumed to be the recommendation target golf club. However, the present invention is also applicable to other types of golf clubs. The information processing apparatus **3** includes a processing unit **31**, a storage unit **32**, and an I/F unit (interface unit) **33** that are electrically connected to each other. The processing unit **31** is a processor such as a CPU. The storage unit **32** includes one or a plurality of storage devices. A storage device is, for example, a RAM, a ROM, a hard disk, or the like. Programs to be executed by the processing unit **31** and various kinds of data are stored in the storage unit **32**. A

program to be executed by the processing unit **31** can be formed by a plurality of instructions which can be read by the processing unit **31**.

[0022] In this embodiment, an artificial intelligence program that estimates the golf club characteristics suitable for the golfer **100** is included as a program to be executed by the processing unit **31**, and a database **32***a* that makes the artificial intelligence perform machine learning is included in the storage unit **32**.

[0023] The I/F unit **33** performs input and output of data between an external device and the processing unit **31**. The I/F unit **33** can include an I/O interface and a communication interface. The measurement device **2** is communicably connected to the information processing apparatus **3** by wired or wireless communication, and the measurement results are obtained by the information processing apparatus **3**.

[0024] The display device **4** and the input device **5** are connected to the information processing apparatus **3**. The display device **4** is, for example, an electronic image display device such as a liquid crystal display device and displays the processing result of the information processing apparatus **3**. The input device **5** is a mouse and a keyboard and accepts data inputs and operation instructions to the information processing apparatus **3**.

[0025] <Overview of Club Selection Support>

[0026] In this embodiment, the swing movement of the golfer **100** is measured by the measurement device **2**, and the information processing apparatus **3** which functions as an artificial intelligence specifies the club characteristics of a golf club suitable for the golfer **100**. As a preparatory stage, the artificial intelligence is provided with, as teacher data, information of club characteristics suitable for the features of each golf swing movement and is made to learn the provided data. If no teacher data is provided, massive amounts of input data would be necessary. However, the amount of data necessary for algorithm formation can be reduced by providing teacher data and making the artificial intelligence learn the teacher data.

[0027] <Learning of Artificial Intelligence>

[0028] FIG. **2** is a flowchart showing the procedure related to the learning process of the artificial intelligence. In step S**1**, the measurement of the swing movement of each of the plurality of testers and the ball-striking tests of a plurality of types of golf clubs by each tester are performed. From the point of machine learning accuracy improvement, it is preferable for the number of testers to be, for example, 100 or more. The measurement of each swing movement will be described first.

[0029] The measurement of each swing movement is performed by using the same device as the measurement device **2** that forms the system **1** of FIG. **1** or a device which has a similar function. Swing movement measurement results to be extracted as feature amounts may be obtained from the entire swing from the address to the finish or may be obtained from a partial range of the swing. In this embodiment, the target is set to be a range from the top until impact in which the characteristics of the golfer can easily appear. FIG. **3**A is an explanatory view of this range.

[0030] FIG. **3**A shows a state in which a tester T has swung a golf club GC and has reached impact. The measurement device **2** has been attached to the golf club GC and measures the swing movement of the golf club GC. The golf club GC may be a club usually used by the tester T as long as it is a type of a club (a driver in this embodiment) which is a selection support target. In FIG. **3**A, a track BS indicates the track of a golf club head during a back swing, and a track DS indicates the track of the golf club head from a top TOP until an impact IP.

[0031] The measurement device **2** measures the behavior of the golf club GC from the address until the follow through after the impact but uses the measurement results from the top TOP until the impact IP as the swing feature data. FIG. **4** exemplifies measurement results D**0** and swing information Din generated from the measurement results D**0**. The swing information Din forms the swing feature data of the golf swing movement. The example of FIG. **4** shows the measurement results of a tester "A".

[0032] Each measurement result D**0** is time-series data representing the behavior of the golf club GC in a predetermined time unit (0.001 sec in this case). In this embodiment, each measurement result D**0** includes the accelerations in the respective three axis-directions of X, Y, and Z and the angular velocities about these respective three axes. That is, each measurement result includes the three-dimensional acceleration and angular velocity data of the golf club GC. Note that, at this time, there is used a right-hand coordinate system in which the X axis is set to be positive in the vertical-axis direction of the shaft, the Y axis is set to be positive in the shot direction (parallel to a vertical plane of the face), and the Z axis is set to be positive in a direction from the head toward the proximal end in the shaft axis direction. The top data and the impact data are specified from these data. For example, since the angular velocity about the X axis or the Y axis tends to change from a negative value to a positive value at the top, this can be specified as the top data. Since the acceleration in the Y-axis direction tends to rapidly decrease at impact, the minimum value of Y-axis acceleration can be specified as the impact data. In the case of the example of FIG. **4**, the data of 0.968 sec has been specified as the top and the data of 1.364 sec has been specified as the impact. As a result, data D**1** from 0.968 sec to 1.364 sec is used as the swing feature data.

[0033] The tempo of the swing differs depending on the person. Hence, the time (number of data) from the top until impact differs. From the point of machine learning accuracy improvement, it is preferable to have a large number of data. In this embodiment, 1000 frames are set as the predetermined number of data, and a known data processing technique can be used to thin out or interpolate any exceeding or insufficient frames. In the case of the example of FIG. **4**, the number of data of the data D**1** is 396 but it has been interpolated and set as the swing information Din of 1000 frames. Although each data array of the swing information Din is not data per each predetermined time unit, it may be called time-series data since it represents the temporal change of the accelerations and angular velocities of the golf club GC.

[0034] Note that in this embodiment, although the swing information Din has been formed as data arrays of the accelerations and the angular velocities of a golf club, the present invention is not limited to this as long as the standard of information is uniform, and any type of physical data and data format (as another example, waveform data) may be used. The swing information Din may be any kind of information as long as the series of behaviors of a golf club or a tester during a swing can be specified.

[0035] The ball-striking test will be described next. In the ball-striking test, a tester performs test shots by using a

plurality of types of golf clubs that have varied club characteristics, and the behavior of each golf club or ball is measured. FIG. **5** shows ball-striking test data D**10** and suitable club information Dout. The suitable club information Dout will be used to form the teacher data. The example of FIG. **5** shows the ball-striking test results of the tester "A".

[0036] The ball-striking test data D**10** is largely classified into information about the golf club used in each ball-striking test and information of each ball-striking result. The example of FIG. **5** shows that ball-striking tests have been performed for 14 clubs (drivers) from club #01 to club #14. Of the plurality of types of club feature amounts, at least one club feature amount is different in each of the 14 clubs. Each club feature amount is a design value that characterizes the golf club. In the example of FIG. **5**, a shaft flex (R, SR, S, and X) which indicates the hardness of a shaft, the weight of a shaft, the center-of-gravity distance of a head (the distance between the center-of-gravity of a head and a shaft axis) are shown as the club feature amounts. Other examples of club feature amounts are the weight of a head, the center-of-gravity angle of a head, the center-of-gravity depth of a head, the loft angle of a head, the lie angle of a head, the face angle of a head, the torque of a shaft, the rigidity of a shaft, the moment of inertia of a head, the moment of inertia of an entire club, the center-of-gravity position of an entire club, the length of a shaft, the weight of a grip, and the like.

[0037] The club characteristics are the classification of golf clubs based on the club feature amounts. In this embodiment, there are four types of club characteristics ranging from 1 to 4. However, there may be five or more types of club characteristics. Although the club characteristics may be set to be three or less types, setting only two types of club characteristics will not contribute much in narrowing down to a recommended golf club.

[0038] In this embodiment, the club characteristics are classified based on the plurality of types of club feature amounts. Although the application of a club characteristic that has been classified by a single type of club feature amount is possible, it may reduce the suitability of the recommended golf club for the golfer. On the other hand, if there are too many types of club feature amounts that classify the club characteristics, the classification becomes complex. Hence, dimensionality reduction of the plurality of types of club feature amounts can be achieved by performing principal component analysis. FIG. **3**B is a schematic view showing an example of this operation.

[0039] FIG. **3**B includes three classification axes U, V, and W, and a space defined by these three axes has been quartered to classify the club characteristics 1 to 4. At least one of the values of the three axes can be regarded as a dimensionality-reduced value obtained by performing principal component analysis of a plurality of types of club feature amounts.

[0040] For example, the value of the U axis can be set as

U=coefficient 1×club weight+coefficient 2×center-of-gravity position of entire club+coefficient 3×shaft flex(shaft flex can be obtained by quantifying *R,SR*, and the like),

[0041] the value of the V axis can be set as

V=coefficient 4×center-of-gravity angle of head+coefficient 5×shaft torque, and

[0042] the value of the W axis can be set as the moment of inertia of the entire club. In this case, the values of the respective U axis and V axis are the dimensionality-reduced values and the value of the W axis is a value that has not undergone dimensionality reduction.

[0043] Referring again to FIG. **5**, the ball-striking results will be described. The ball-striking results are the evaluation criteria for a golf club that suits the swing movement of the tester. In the example of FIG. **5**, the head speed, the carry of the golf ball, the face angle at impact, and sensory evaluation are shown as the four criteria. The face angle at impact is the direction of the face of the head at impact and is measured by setting a state in which the face is perpendicular to a ball-line direction as 0° on a plane parallel to a horizontal plane. The head speed, the carry, and the face angle at impact are measurable by various types of measurement devices. For example, it can use a ball-flight measurement device arranged in the back of the ball line with respect to the golf ball that is to be struck. As such a measurement device, for example, TRACKMAN available from TRACKMAN GOLF can be used.

[0044] Sensory evaluation is a criterion obtained by quantifying a tester's experience items such as the hitting sound, the hitting feel, and the swing ease, and uses a five-point rating scale ranging from 1 to 5 in the example of FIG. **5**. 1 is the worst value, and 5 is the best value. The sensory evaluation may be formed from one type of experience item or may be formed from a plurality of experience items. The plurality of experience items may be set as a dimensionality-reduced value by performing principal component analysis. For example, it may be set as

sensory evaluation=coefficient 6×hitting sound value+coefficient 7×hitting feel value+coefficient 8×swing ease value.

[0045] The evaluation criteria are not limited to the four types shown in FIG. **5** and may be, for example, the side spin amount of a golf ball, the back spin amount of a golf ball, and the like. Also, although a plurality of types of evaluation criteria have been used in this embodiment, only one type of evaluation criterion may be used.

[0046] The suitable club information Dout is created from the ball-striking test data D**10**. The suitable club information Dout is information that indicates the club characteristics of a golf club which has the highest evaluation. In the ball-striking test data D**10** of FIG. **5**, club #03 has the highest head speed. Since the club characteristic of club #03 is "2", the suitable club characteristic related to the head speed of the tester A is "2". Club #09 has the longest carry. Since the club characteristic of club #09 is "1", the suitable club characteristic related to the carry of the tester A is "1". As the club whose face angle at impact is closest to square (0°) is club #12, the suitable club characteristic related to the face angle at impact of the tester A is "4". Club #02 has the best sensory evaluation, and the suitable club characteristic related to the sensory evaluation of the tester A is "5". As a principle, one type of characteristic is used as a suitable club characteristic with respect to each evaluation criterion. However, a plurality of types of club characteristics may be associated if there are clubs that have the same score.

[0047] In this embodiment, the suitable club information Dout shows the relation between the evaluation criteria and the club characteristics. This means that the golf club used for the ball-striking test can be different for each tester. That is, although the tester A used 14 clubs (drivers) ranging from

#01 to #14 to perform the ball-striking tests in the example of FIG. **5**, it is not necessary for another tester to use the same 14 clubs. It is sufficient as long as a plurality of types of golf clubs that have different club characteristics are used to perform the ball-striking tests.

[0048] Referring back to FIG. **2**, a combination of swing information Din and the suitable club information Dout is prepared for each tester by the ball-striking test of the above-described step S**1**. In step S**2**, data to be used for machine learning is created. As shown in FIG. **6**, data Dt is the combination of the swing information Din and the suitable club information Dout serving as teacher data. That is, FIG. **6** exemplifies the combination of the teacher data and the swing characteristic data of the swing movement related to the tester A, and this combination is created for each tester. The swing information Din and the suitable club information Dout are in a relation in which the former is the input and the latter is the output. These data are input to the information processing apparatus **3** and stored in the database **32***a* of the storage unit **32**.

[0049] In step S**3**, machine learning is executed in the information processing apparatus **3**. The processing unit **31** reads out the data Dt stored in the database **32***a* and generates an artificial intelligence algorithm to derive the suitable club information Dout from the swing information Din by executing machine learning. The generated algorithm is stored in the storage unit **32**. After the algorithm has been generated, the algorithm may be updated by periodically adding new swing feature data and teacher data and executing machine learning again.

[0050] <Selection Support Processing>

[0051] The support processing performed when a golfer is to select a golf club by using the system **1** shown in FIG. **1** will be described next. The information processing apparatus **3** of the system **1** is has completed machine learning by executing the above-described procedures. FIG. **7** is a flowchart showing an example of the selection support processing and is processing executed by the processing unit **31** of the information processing apparatus **3**.

[0052] In step S**11**, the swing movement of the golfer is measured by the measurement device **2**. Here, the golfer **100** actually strikes a golf ball by using the golf club **101**, and the measurement device **2** measures the behavior of the golf club **101**. The golf club **101** may be a club usually used by the golfer.

[0053] In step S**12**, measurement results are obtained from the measurement device **2**. The information processing apparatus **3** obtains the same data as the measurement results D**0** of FIG. **4** from the measurement device **2**. In step S**13**, swing information D**11** is created from the measurement results obtained in step S**12**. The swing information D**11** is created in the same manner as the swing information Din of FIG. **4**.

[0054] In step S**14**, the artificial intelligence selects, from the swing information D**11** created in step S**13**, a club characteristic suitable for the golfer for each evaluation criterion and creates club characteristic information D**12**. In the case of FIG. **7**, characteristic 3 has been selected for the head speed and the carry, characteristic 2 has been selected for the face angle at impact, and characteristic 4 has been selected for the sensory evaluation.

[0055] In step S**15**, product information D**13** of golf clubs is obtained. The product information D**13** is stored in the storage unit **32**. The product information D**13** includes information about the types, the club characteristics, and the specifications of golf clubs. In the example of FIG. **7**, the club characteristics and the specifications of 9 types of golf clubs from A to I have been recorded. Each specification corresponds to club feature amounts. From the viewpoint of the head speed and the carry, golf clubs E and G are suitable for the golfer. From the viewpoint of the face angle at impact, golf clubs C and D are suitable for the golfer. From the viewpoint of sensory evaluation, golf clubs B and H are suitable for the golfer.

[0056] In step S**16**, the information of the recommended golf clubs is displayed on the display device **4**. Here, the golf club information suitable for the golfer may be displayed for each of the four evaluation criteria or the golf club information suitable for the golfer may be displayed for one evaluation criterion or each of a plurality of evaluation criteria desired by the golfer. In addition, other than the golf club information, the swing measurement results of the golfer may be displayed.

[0057] The selection support processing thus ends from the above procedures. Subsequently, by performing test shots using each recommended golf club displayed in step S**16**, the golfer can actually experience whether the club is suitable for him/her. By using artificial intelligence, this embodiment can analyze a wider range of series of swing movements and determine the suitable club characteristics. Hence, it is possible to make a more multifaceted determination and more accurately determine the club characteristics suitable for a golfer.

OTHER EMBODIMENTS

[0058] The system of FIG. **1** has exemplified a measurement device **2** and an information processing apparatus **3** that are arranged in a comparatively short distance from each other and capable of being placed in a shop or the like. However, it is possible to adopt another arrangement example. It is also possible to adopt a measurement device other than that shown in FIG. **1**.

[0059] FIG. **8** shows another arrangement example of a selection support system **1**. In the arrangement example of FIG. **8**, an information processing apparatus **3** can serve as a server to communicate with a communication device (such as a portable terminal **112** or a personal computer **115**) via a network **110** and distribute information related to each golf club. The network **110** is, for example, the Internet.

[0060] A measurement-side arrangement example Ex**1** is a system including the portable terminal **112** and the measurement device **2**. The portable terminal **112** is, for example, a smartphone and includes a short-range wireless communication function with the measurement device **2** and a wireless communication function via the network **110** and a base station (not shown). The measurement results of the measurement device **2** are transmitted to the portable terminal **112**. The portable terminal **112** transmits, to the information processing apparatus **3**, the received measurement results as is or as data of a predetermined format which is processable on the side of the information processing apparatus **3**. The information processing apparatus **3** specifies each recommended golf club and transmits the information to the portable terminal **112**. The portable terminal **112** displays the received information. That is, the process of step S**11** of FIG. **7** is executed in the measurement device **2**, the process of step S**12** is executed in the portable terminal **112** and the information processing apparatus **3**, the pro-

cesses of steps S13 and S14 are executed in the information processing apparatus 3, the process of step S15 is executed in the portable terminal 112 and the information processing apparatus 3, and the process of step S16 is executed in the portable terminal 112. However, the execution method is not limited to this. For example, the recommended golf club may be specified by the portable terminal 112 by executing the process of step S14 in the information processing apparatus 3 and transmitting the information generated in step S14 to the portable terminal 112.

[0061] A measurement-side arrangement example Ex2 is a system including the personal computer 115 and a plurality of measurement devices 2A. Each measurement device 2A is an image capturing apparatus such as a video camera. The personal computer 115 includes a function to process the images captured by the image capturing devices 2A and a wireless communication function via the network 110. The golfer performs the test shot in a test shot room or the like. The three-dimensional behavior of a golf club 101 is captured by capturing the golfer from various directions by the plurality of image capturing apparatuses 2A in the test shot room. The captured images are loaded and analyzed in the personal computer 115 and subsequently transmitted to the information processing apparatus 3 as data of a predetermined format which is processable on the side of the information processing apparatus 3. The information processing apparatus 3 specifies each recommended golf club and transmits the information to the personal computer 115. The personal computer 115 displays the received information. That is, the process of step S11 of FIG. 7 is executed in the measurement devices 2A, the process of step S12 is executed in the personal computer 115 and the information processing apparatus 3, the processes of steps S13 and S14 are executed in the information processing apparatus 3, the process of step S15 is executed in the personal computer 115 and the information processing apparatus 3, and the process of step S16 is executed in the personal computer 115. However, the execution method is not limited to this. For example, the recommended golf club may be specified by the personal computer 115 by executing the process of step S14 in the information processing apparatus 3 and transmitting the information generated in step S14 to the personal computer 115.

[0062] While the present invention has been described with reference to exemplary embodiments, it is to be understood that the invention is not limited to the disclosed exemplary embodiments. The scope of the following claims is to be accorded the broadest interpretation so as to encompass all such modifications and equivalent structures and functions.

[0063] This application claims the benefits of Japanese Patent Application No. 2016-248316, filed Dec. 21, 2016, which is hereby incorporated by reference herein in its entirety.

What is claimed is:

1. A selection support apparatus comprising:

an obtaining unit configured to obtain a measurement result of a golf swing movement of a golfer; and

a selection unit configured to select, from a plurality of types of club characteristics of a golf club, a club characteristic suitable for the golfer based on the measurement result,

wherein the selection unit selects a club characteristic suitable for the golfer based on machine learning results of teacher data indicating a club characteristic suitable for a golf swing movement of each tester of a plurality of testers.

2. The apparatus according to claim 1, wherein the plurality of types of club characteristics are classified based on a plurality of types of club feature amounts.

3. The apparatus according to claim 1, wherein the plurality of types of club characteristics are classified based on a value obtained by performing dimensionality reduction of a plurality of types of club feature amounts.

4. The apparatus according to claim 1, wherein the measurement result includes time-series data of acceleration and time-series data of angular velocity of a golf club during a swing.

5. The apparatus according to claim 1, wherein the selection unit selects the club characteristic suitable for the golfer based on the measurement result from a top until an impact.

6. The apparatus according to claim 1, wherein the selection unit selects the club characteristic for each of a plurality of types of evaluation criteria, and

the teacher data is data indicating, for the plurality of testers, the club characteristic suitable for the golf swing movement of each tester.

7. The apparatus according to claim 6, wherein the plurality of types of evaluation criteria include at least a head speed, a carry of a golf ball, a face angle at impact, and/or a sensory evaluation.

8. The apparatus according to claim 6, wherein the selection unit selects the club characteristic based on a sensory evaluation as an evaluation criterion,

the teacher data is data indicating, as the sensory evaluation as the evaluation criterion, the club characteristic suitable for the golf swing movement of each tester of the plurality of testers, and

the sensory evaluation is defined by quantifying experience items and obtaining a dimensionality-reduced value of the quantified experience items.

9. A selection support system comprising:

a measurement device configured to measure a golf swing movement of a golfer; and

an information processing apparatus configured to select, from a plurality of types of club characteristics of a golf club, a club characteristic suitable for the golfer based on a measurement result of the measurement device,

wherein the information processing apparatus selects a club characteristic suitable for the golfer based on machine learning results of teacher data indicating a club characteristic suitable for a golf swing movement of each tester of a plurality of testers.

10. A selection support method comprising:

measuring a golf swing movement of a golfer; and

selecting, from a plurality of types of club characteristics of a golf club, a club characteristic suitable for the golfer based on the measurement result of the measurement,

wherein a club characteristic suitable for the golfer is selected in the selecting based on machine learning results of teacher data indicating a club characteristic suitable for a golf swing movement of each tester of a plurality of testers.

11. The method according to claim **10**, wherein the teacher data is generated based on results of test shots performed by the plurality of testers by using a plurality of golf clubs.

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