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DETECTION SYSTEM, DETECTION METHOD, AND COMPUTER-READABLE STORAGE MEDIUM

Abstract

A detection system comprises a load sensor and electronic controller circuitry. The load sensor is configured to obtain load information relating to a load applied, while a rider rides a human-powered vehicle, to a wheel of the human-powered vehicle. The electronic controller circuitry is configured to obtain, based on the load information, motion information relating to a motion of the human-powered vehicle.

Publication Classification

Background/Summary

BACKGROUND
Technical Field
[0001] The present invention relates to a detection system, a detection method, and a computer-readable storage medium.
Background Information
[0002] A human-powered vehicle has various motions such as traveling forward, traveling on bumps, staying in substantially the same position while both feet of the rider are put on pedals. The human-powered vehicle includes a sensor to detect a motion of the human-powered vehicle. One of objects of the present disclosure is to improve the accuracy of motion information.
SUMMARY
[0003] In accordance with a first aspect of the present invention, a detection system comprises a load sensor and electronic controller circuitry. The load sensor is configured to obtain load information relating to a load applied, while a rider rides a human-powered vehicle, to a wheel of the human-powered vehicle. The electronic controller circuitry is configured to obtain, based on the load information, motion information relating to a motion of the human-powered vehicle.
[0004] With the detection system according to the first aspect, it is possible to obtain the motion information relating to the motion of the human-powered vehicle using the load information relating to the load applied to the wheel. Thus, it is possible to improve the accuracy of the motion information.
[0005] In accordance with a second aspect of the present invention, the detection system according to the first aspect is configured so that the load information includes air pressure information relating to an air pressure of the wheel. The load sensor is configured to obtain the air pressure information. The electronic controller circuitry is configured to obtain the motion information based on the air pressure information.
[0006] With the detection system according to the second aspect, it is possible to reliably improve the accuracy of the motion information.
[0007] In accordance with a third aspect of the present invention, the detection system according to the first or second aspect is configured so that the motion information includes a technical level of the rider. The electronic controller circuitry is configured to determine the technical level based on the load information.
[0008] With the detection system according to the third aspect, it is possible to obtain the technical level of the rider based on the load information.
[0009] In accordance with a fourth aspect of the present invention, the detection system according to the third aspect is configured so that the technical level includes a level of a standstill technique that the rider maintains balance while the human-powered vehicle remains stationary or moves only minimal distances. The electronic controller circuitry is configured to determine the level of the standstill technique based on the load information.
[0010] With the detection system according to the fourth aspect, it is possible to obtain the level of the standstill technique based on the load information.
[0011] In accordance with a fifth aspect of the present invention, the detection system according to the third or fourth aspect is configured so that the technical level includes a level of a neutral technique that the rider absorbs a bump of a road to reduce shocks applied to the wheel while the rider rides the human-powered vehicle. The electronic controller circuitry is configured to determine the level of the neutral technique based on the load information.
[0012] With the detection system according to the fifth aspect, it is possible to obtain the level of the neutral technique based on the load information.
[0013] In accordance with a sixth aspect of the present invention, the detection system according to any one of the third to fifth aspects is configured so that the load sensor includes a front load sensor and a rear load sensor. The front load sensor is configured to obtain front load information relating

to a front load applied, while the rider rides the human-powered vehicle, to a front wheel of the human-powered vehicle. The rear load sensor is configured to obtain rear load information relating to a rear load applied, while the rider rides the human-powered vehicle, to a rear wheel of the human-powered vehicle. The electronic controller circuitry is configured to determine the technical level based on at least one of the front load information and the rear load information.

[0014] With the detection system according to the sixth aspect, it is possible to improve the accuracy of the technical level of the rider.

[0015] In accordance with a seventh aspect of the present invention, the detection system according to the sixth aspect is configured so that the electronic controller circuitry is configured to determine the technical level based on a load difference between the front load information and the rear load information.

[0016] With the detection system according to the seventh aspect, it is possible to reliably improve the accuracy of the technical level of the rider.

[0017] In accordance with an eighth aspect of the present invention, the detection system according to the seventh aspect is configured so that the electronic controller circuitry is configured to determine the technical level based on a change in the load difference.

[0018] With the detection system according to the eighth aspect, it is possible to reliably improve the accuracy of the technical level of the rider.

[0019] In accordance with a ninth aspect of the present invention, the detection system according to the eighth aspect is configured so that the electronic controller circuitry is configured to calculate standard deviation of the load difference. The electronic controller circuitry is configured to determine the technical level based on the standard deviation.

[0020] With the detection system according to the ninth aspect, it is possible to more reliably improve the accuracy of the technical level of the rider.

[0021] In accordance with a tenth aspect of the present invention, the detection system according to the ninth aspect is configured so that the technical level includes a first technical level and a second technical level. The electronic controller circuitry is configured to select the first technical level in a case where the standard deviation is less than a first level threshold. The electronic controller circuitry is configured to select the second technical level in a case where the standard deviation is greater than the first level threshold.

[0022] With the detection system according to the tenth aspect, it is possible to more reliably improve the accuracy of the technical level of the rider.

[0023] In accordance with an eleventh aspect of the present invention, the detection system according to any one of the third to tenth aspects is configured so that the electronic controller circuitry is configured to determine the technical level based on a change in the load information.

[0024] With the detection system according to the eleventh aspect, it is possible to reliably improve the accuracy of the technical level of the rider.

[0025] In accordance with a twelfth aspect of the present invention, the detection system according to the eleventh aspect is configured so that the load sensor includes at least one of a front load sensor and a rear load sensor. The front load sensor is configured to obtain front load information relating to a front load applied, while the rider rides the human-powered vehicle, to a front wheel of the human-powered vehicle. The rear load sensor is configured to obtain rear load information relating to a rear load applied, while the rider rides the human-powered vehicle, to a rear wheel of the human-powered vehicle. The electronic controller circuitry is configured to determine the technical level based on at least one of a change in the front load information and a change in the rear load information.

[0026] With the detection system according to the twelfth aspect, it is possible to reliably improve the accuracy of the technical level of the rider.

[0027] In accordance with a thirteenth aspect of the present invention, the detection system according to the eleventh or twelfth aspect is configured so that the technical level includes a first

technical level and a second technical level. The electronic controller circuitry is configured to select the first technical level in a case where the change in the load information is less than a second level threshold. The electronic controller circuitry is configured to select the second technical level in a case where the change in the load information is greater than the second level threshold.

[0028] With the detection system according to the thirteenth aspect, it is possible to reliably improve the accuracy of the technical level of the rider.

[0029] In accordance with a fourteenth aspect of the present invention, the detection system according to any one of the first to thirteenth aspects is configured so that the motion information includes at least one of a cadence and a vehicle speed of the human-powered vehicle. The electronic controller circuitry is configured to calculate at least one of the cadence and the vehicle speed based on the load information.

[0030] With the detection system according to the fourteenth aspect, it is possible to obtain the cadence and the vehicle speed with a comparatively simple structure.

[0031] In accordance with a fifteenth aspect of the present invention, the detection system according to the fourteenth aspect is configured so that the load sensor includes a rear load sensor configured to obtain rear load information relating to a rear load applied, while the rider rides the human-powered vehicle, to a rear wheel of the human-powered vehicle. The electronic controller circuitry is configured to calculate at least one of the cadence and the vehicle speed based on the rear load information.

[0032] With the detection system according to the fifteenth aspect, it is possible to reliably obtain the cadence and the vehicle speed with a comparatively simple structure.

[0033] In accordance with a sixteenth aspect of the present invention, the detection system according to the fifteenth aspect is configured so that the rear load information includes rear air pressure information relating to a rear air pressure of the rear wheel. The rear load sensor is configured to obtain the rear air pressure information. The electronic controller circuitry is configured to calculate at least one of the cadence and the vehicle speed based on the rear air pressure information.

[0034] With the detection system according to the sixteenth aspect, it is possible to more reliably obtain the cadence and the vehicle speed with a comparatively simple structure.

[0035] In accordance with a seventeenth aspect of the present invention, the detection system according to any one of the fourteenth to sixteenth aspects is configured so that the electronic controller circuitry is configured to calculate at least one of the cadence and the vehicle speed based on a change in the load information.

[0036] With the detection system according to the seventeenth aspect, it is possible to reliably obtain the cadence and the vehicle speed with a comparatively simple structure.

[0037] In accordance with an eighteenth aspect of the present invention, the detection system according to any one of the fourteenth to seventeenth aspects is configured so that the electronic controller circuitry is configured to calculate at least one of the cadence and the vehicle speed based on a total number of peaks of the load information per unit time.

[0038] With the detection system according to the eighteenth aspect, it is possible to reliably obtain the cadence and the vehicle speed with a comparatively simple structure.

[0039] In accordance with a nineteenth aspect of the present invention, a detection method comprises: obtaining load information relating to a load applied, while a rider rides a human-powered vehicle, to a wheel of the human-powered vehicle; and obtaining, based on the load information, motion information relating to a motion of the human-powered vehicle.

[0040] With the detection method according to the nineteenth aspect, it is possible to obtain the motion information relating to the motion of the human-powered vehicle using the load information relating to the load applied to the wheel. Thus, it is possible to improve the accuracy of the motion information.

[0041] In accordance with a twentieth aspect of the present invention, a computer-readable storage medium stores program instructions for causing electronic controller circuitry to execute a detection method comprising: obtaining load information relating to a load applied, while a rider rides a human-powered vehicle, to a wheel of the human-powered vehicle; and obtaining, based on the load information, motion information relating to a motion of the human-powered vehicle.

[0042] With the computer-readable storage medium according to the first aspect, it is possible to obtain the motion information relating to the motion of the human-powered vehicle using the load information relating to the load applied to the wheel. Thus, it is possible to improve the accuracy of the motion information.

Description

BRIEF DESCRIPTION OF THE DRAWINGS

[0043] A more complete appreciation of the invention and many of the attendant advantages thereof will be readily obtained as the same becomes better understood by reference to the following detailed description when considered in connection with the accompanying drawings.

[0044] FIG. **1** is a side elevational view of a human-powered vehicle including a detection system in accordance with one of embodiments.

[0045] FIG. **2** is a schematic block diagram of the detection system of the human-powered vehicle illustrated in FIG. **1**.

[0046] FIG. **3** shows graphs of motion information and pedaling torque of the human-powered vehicle illustrated in FIG. **1**.

[0047] FIGS. **4** to **7** show a flowchart of the detection system of the human-powered vehicle illustrated in FIG. **1**.

DESCRIPTION OF THE EMBODIMENTS

[0048] The embodiments will now be described with reference to the accompanying drawings, wherein like reference numerals designate corresponding or identical elements throughout the various drawings.

[0049] Referring initially to FIG. **1**, a human-powered vehicle B includes a detection system **10** in accordance with one of embodiments. The human-powered vehicle B includes at least one human-powered vehicle component BC. In the present embodiment, the human-powered vehicle B is illustrated as an e-bike that uses a driving force of an electric motor in addition to a human driving force for propulsion. However, the detection system **10** can be applied to any other type of human-powered vehicles such as, for example, a mountain bike, a cyclocross bicycle, a gravel bike, a city bike, a cargo bike, and a recumbent bike.

[0050] In the present application, the term "human-powered vehicle" includes a vehicle to travel with a motive power including at least a human power of a user who rides the vehicle. The human-powered vehicle includes a various kind of bicycles such as a mountain bike, a road bike, a city bike, a cargo bike, a hand bike, and a recumbent bike. Furthermore, the human-powered vehicle includes an electric bike called as an E-bike. The electric bike includes an electrically assisted bicycle configured to assist propulsion of a vehicle with an electric motor. However, a total number of wheels of the human-powered vehicle is not limited to two. For example, the human-powered vehicle includes a vehicle having one wheel or three or more wheels. Especially, the human-powered vehicle does not include a vehicle that uses only a driving source as motive power. Examples of the driving source include an internal-combustion engine and an electric motor. Generally, a light road vehicle, which includes a vehicle that does not require a driver's license for a public road, is assumed as the human-powered vehicle.

[0051] As seen in FIG. **1**, the human-powered vehicle B includes a vehicle body VB, a wheel FW, and a wheel RW. The wheel FW is rotatably coupled to the vehicle body VB. The wheel RW is

rotatably coupled to the vehicle body VB. The vehicle body VB is supported by the wheels FW and RW. The wheel FW can also be referred to as a front wheel FW. The wheel RW can also be referred to as a rear wheel RW.

[0052] The vehicle body VB includes a front frame body FB, a rear frame body RB, a handlebar H, and a front fork FF. The rear frame body RB includes a swing arm. The rear frame body RB is movably coupled to the front frame body FB. The rear frame body RB is pivotally coupled to the front frame body FB. The front fork FF is pivotally coupled to the front frame body FB. The handlebar H is coupled to the front fork FF to be pivotable relative to the front frame body FB along with the front fork FF.

[0053] The human-powered vehicle B further includes a drivetrain DT. Here, for example, the drivetrain DT is a chain-drive type and includes a crank CR, at least one front sprocket FS, at least two rear sprockets RS, a chain CH, and pedals PD. The crank CR is rotatably coupled to the vehicle body VB. The at least one front sprocket FS is coupled to the crank CR to rotate relative to the vehicle body VB along with the crank CR. The rear sprockets RS are provided on a hub assembly FH of the wheel RW. The chain CH is configured to be engaged with one of the at least one front sprocket FS and one of the at least two rear sprockets RS. The pedals PD are coupled to the crank CR. A human driving force is applied to the pedals PD by a rider such that the driving force is transmitted to the wheel RW via the at least one front sprocket FS, the chain CH, and the at least two rear sprockets RS. While the drivetrain DT is illustrated as a chain-drive type of drivetrain, the drivetrain DT can be selected from any type of drivetrain and can be a belt-drive type or a shaft-drive type.

[0054] In the present application, the following directional terms "front," "rear," "forward," "rearward," "left," "right," "transverse," "upward" and "downward" as well as any other similar directional terms refer to those directions which are determined based on the user who is in the user's standard position in the human-powered vehicle B while the user faces toward a handlebar or steering. Examples of the user's standard position include a saddle and a seat. Accordingly, these terms, as utilized to describe the detection system **10**, the human-powered vehicle component BC, or other components, should be interpreted relative to the human-powered vehicle B equipped with the detection system **10**, the human-powered vehicle component BC, or other components as used in an upright riding position on a horizontal surface.

[0055] As seen in FIG. **1**, the at least one human-powered vehicle component BC includes a gear changer **12**, a suspension **16**, a suspension **18**, an adjustable seatpost **20**, and an assist drive unit **22**. Namely, the human-powered vehicle B includes the gear changer **12**, the suspension **16**, the suspension **18**, the adjustable seatpost **20**, and the assist drive unit **22**. The gear changer **12** is configured to be mounted to the vehicle body VB. The suspension **16** is configured to be mounted to the vehicle body VB. The suspension **18** is configured to be mounted to the vehicle body VB. The adjustable seatpost **20** is configured to be mounted to the vehicle body VB. The assist drive unit **22** is configured to be mounted to the vehicle body VB.

[0056] The gear changer **12** is configured to change a gear ratio of the human-powered vehicle B. The gear ratio is a ratio of a rotational speed of the at least two rear sprockets RS to a rotational speed of the at least one front sprocket FS. The gear changer **12** is configured to shift the chain CH relative to the at least two rear sprockets RS. In the present embodiment, the gear changer **12** includes a rear derailleur. However, the gear changer **12** can include another type of gear changer if needed or desired. Examples of another type of gear changer include a front derailleur and an internal-gear hub.

[0057] The suspension **16** is configured to absorb or damp shocks or vibrations generated by riding on rough terrain. The suspension **16** is installed in the front fork FF. The suspension **16** and the front fork FF constitute a suspension fork. The suspension **16** is configured to absorb or damp shocks or vibrations transmitted from at least one of the wheels FW and RW.

[0058] The suspension **18** is configured to absorb or damp shocks or vibrations generated by riding

on rough terrain. The suspension **18** is coupled to the front frame body FB and the rear frame body RB. The suspension **18** is configured to absorb or damp shocks or vibrations transmitted from at least one of the wheels FW and RW.

[0059] The adjustable seatpost **20** is configured to change a height of the saddle S relative to the vehicle body VB. The adjustable seatpost **20** has an adjustable state and a locked state. The adjustable seatpost **20** allows the user to change the height of the saddle S in the adjustable state. The adjustable seatpost **20** is locked to maintain the height of the saddle S in the locked state. The adjustable seatpost **20** is configured to change the state of the adjustable seatpost **20** between the adjustable state and the locked state.

[0060] The assist drive unit **22** is configured to assist propulsion of the human-powered vehicle B. The assist drive unit **22** is configured to change an assist ratio depending on a human power applied to the human-powered vehicle B. For example, the assist drive unit **22** is configured to change the assist ratio depending on pedaling torque applied to the crank CR.

[0061] As seen in FIG. **1**, the human-powered vehicle B includes a first operating device **24** and a second operating device **26**. The first operating device **24** is configured to be mounted to the handlebar H (see e.g., FIG. **1**) in a conventional manner. The first operating device **24** is configured to receive a first user operation. The first operating device **24** is configured to operate at least one of the at least one human-powered vehicle component BC in response to the first user operation. The second operating device **26** is configured to be mounted to the handlebar H (see e.g., FIG. **1**) in a conventional manner. The second operating device **26** is configured to receive a second user operation. The second operating device **26** is configured to operate at least one of the at least one human-powered vehicle component BC in response to the second user operation.

[0062] The first operating device **24** is configured to operate at least one of the gear changer **12**, the suspension **16**, the suspension **18**, the adjustable seatpost **20**, and the assist drive unit **22** in response to the first user operation. The second operating device **26** is configured to operate at least one of the gear changer **12**, the suspension **16**, the suspension **18**, the adjustable seatpost **20**, and the assist drive unit **22** in response to the second user operation. The at least one human-powered vehicle component BC can include another operating device other than the first operating device **24** and the second operating device **26** if needed or desired.

[0063] The first operating device **24** is electrically connected to at least one of the gear changer **12**, the suspension **16**, the suspension **18**, the adjustable seatpost **20**, and the assist drive unit **22**. The second operating device **26** is electrically connected to another of the gear changer **12**, the suspension **16**, the suspension **18**, the adjustable seatpost **20**, and the assist drive unit **22**. In the present embodiment, the first operating device **24** is wirelessly connected to at least one of the gear changer **12**, the suspension **16**, the suspension **18**, the adjustable seatpost **20**, and the assist drive unit **22**. The second operating device **26** is wirelessly connected to another of the gear changer **12**, the suspension **16**, the suspension **18**, the adjustable seatpost **20**, and the assist drive unit **22**. However, the first operating device **24** can be electrically connected to at least one of the gear changer **12**, the suspension **16**, the suspension **18**, the adjustable seatpost **20**, and the assist drive unit **22** via an electric cable if needed or desired. The second operating device **26** can be electrically connected to another of the gear changer **12**, the suspension **16**, the suspension **18**, the adjustable seatpost **20**, and the assist drive unit **22** via an electric cable if needed or desired.

[0064] As seen in FIG. **1**, the human-powered vehicle B includes an electric power source PS. Here, the electric power source PS includes a battery pack that includes one or more batteries. The electric power source PS is configured to be mounted to the vehicle body VB. For example, the electric power source PS is configured to be provided in the downtube of the vehicle body VB. Alternatively, the electric power source PS can be attached an outer surface of the vehicle body VB. For example, the electric power source PS includes one or more rechargeable batteries.

[0065] The electric power source PS is configured to be electrically connected to at least one of the at least one human-powered vehicle component BC to supply electrical power to the at least one of

the at least one human-powered vehicle component BC. The electric power source PS is configured to be electrically connected to at least one of the gear changer **12**, the suspension **16**, the suspension **18**, the adjustable seatpost **20**, the assist drive unit **22**, the first operating device **24**, and the second operating device **26**. The electric power source PS is configured to supply electrical power to the at least one of the gear changer **12**, the suspension **16**, the suspension **18**, the adjustable seatpost **20**, the assist drive unit **22**, the first operating device **24**, and the second operating device **26**.

[0066] As seen in FIG. **2**, the detection system **10** comprises electronic controller circuitry EC**1**. The detection system **10** comprises communicator circuitry CC**1**. The detection system **10** includes an electric device ED. The electric device ED includes the electronic controller circuitry EC**1** and the communicator circuitry CC**1**. Examples of the electric device ED includes a smartphone, a tablet computer, a personal computer, a wearable device, and a cycle computer. Examples of the wearable device include a watch, a bracelet, a ring, a necklace, a belt, a helmet, and a device attachable to these items. In the present embodiment, the electric device ED has a function other than a function relating to the human-powered vehicle B. The electronic controller circuitry EC**1** has a function other than the function relating to the human-powered vehicle B. However, the electric device ED can have only a function relating to the human-powered vehicle B if needed or desired. The electronic controller circuitry EC**1** can have only a function relating to the human-powered vehicle B if needed or desired. The electric device ED can also be referred to as an external device ED.

[0067] The electronic controller circuitry EC**1** is electrically connected to the communicator circuitry CC**1**. The communicator circuitry CC**1** is configured to wirelessly communicate with another communication device. The electronic controller circuitry EC**1** is electrically connected to the communicator circuitry CC**1** to control the communicator circuitry CC**1**.

[0068] The electronic controller circuitry EC**1** includes a processor EC**11** and a memory EC**12**. The electric device ED includes a circuit board EC**13** and a system bus EC**14**. The communicator circuitry CC**1** and the electronic controller circuitry EC**1** are electrically mounted on the circuit board EC**13**. The electronic controller circuitry EC**1** is coupled to the communicator circuitry CC**1**. The processor EC**11** and the memory EC**12** are electrically mounted on the circuit board EC**13**. The processor EC**11** is coupled to the memory EC**12**. The memory EC**12** is coupled to the processor EC**11**. The processor EC**11** is electrically connected to the memory EC**12** via the circuit board EC**13** and the system bus EC**14**. The memory EC**12** is electrically connected to the processor EC**11** via the circuit board EC**13** and the system bus EC**14**. For example, the electronic controller circuitry EC**1** includes a semiconductor. The processor EC**11** includes a semiconductor. The memory EC**12** includes a semiconductor. However, the electronic controller circuitry EC**1** can be free of a semiconductor if needed or desired. The processor EC**11** can be free of a semiconductor if needed or desired. The memory EC**12** can be free of a semiconductor if needed or desired.

[0069] For example, the processor EC**11** includes at least one of a central processing unit (CPU), a micro processing unit (MPU), a graphics processing unit (GPU), and a memory controller. The memory EC**12** is electrically connected to the processor EC**11**. For example, the memory EC**12** includes at least one of a volatile memory and a non-volatile memory. Examples of the volatile memory include a random-access memory (RAM) and a dynamic random-access memory (DRAM). Examples of the non-volatile memory include a read only memory (ROM), an electrically erasable programmable ROM (EEPROM), and a magnetic disc. The memory EC**12** includes storage areas each having an address. The processor EC**11** is configured to control the memory EC**12** to store data in the storage areas of the memory EC**12** and reads data from the storage areas of the memory EC**12**. The processor EC**11** can also be referred to as a hardware processor EC**11** or a processor circuit or circuitry EC**11**. The memory EC**12** can also be referred to as a hardware memory EC**12** or a memory circuit or circuitry EC**12**. The memory EC**12** can also be referred to as a non-transitory computer-readable storage medium EC**12**. Namely, the electronic controller circuitry EC**1** includes the non-transitory computer-readable storage medium EC**12**.

[0070] The electronic controller circuitry EC**1** is configured to execute at least one control algorithm of the electric device ED. For example, the electronic controller circuitry EC**1** is programed to execute at least one control algorithm of the electric device ED. The memory EC**12** stores at least one program including at least one program instruction. The at least one program is read into the processor EC**11**, and thereby the at least one control algorithm of the electric device ED is executed based on the at least one program.

[0071] The structure of the electronic controller circuitry EC**1** is not limited to the above structure. The structure of the electronic controller circuitry EC**1** is not limited to the processor EC**11** and the memory EC**12**. The electronic controller circuitry EC**1** can be realized by hardware alone or a combination of hardware and software. In the present embodiment, the processor EC**11** and the memory EC**12** are integrated as a single chip such as an application specific integrated circuit (ASIC) or a field programmable gate array (FPGA). However, the processor EC**11** and the memory EC**12** can be separate chips if needed or desired. The electronic controller circuitry EC**1** can include the processor EC**11**, the memory EC**12**, the circuit board EC**13**, and the system bus EC**14** if needed or desired.

[0072] The electronic controller circuitry EC**1** can include at least two electronic controller circuits which are separately provided. The at least one control algorithm of the electric device ED can be executed by the at least two electronic controller circuits if needed or desired. The electronic controller circuitry EC**1** can include at least two processors which are separately provided. The electronic controller circuitry EC**1** can include at least two memories which are separately provided. The at least one control algorithm of the electric device ED can be executed by the at least two processors if needed or desired. The at least one control algorithm of the electric device ED can be stored in the at least two memories if needed or desired. The electronic controller circuitry EC**1** can include at least two circuit boards which are separately provided if needed or desired. The electronic controller circuitry EC**1** can include at least two system buses which are separately provided if needed or desired.

[0073] The communicator circuitry CC**1** is electrically mounted on the circuit board EC**13**. The communicator circuitry CC**1** is electrically connected to the processor EC**11** and the memory EC**12** with the circuit board EC**13** and the system bus EC**14**.

[0074] The communicator circuitry CC**1** includes wireless communicator circuitry WC**1**.

[0075] The wireless communicator circuitry WC**1** is configured to wirelessly communicate with another wireless communicator circuitry. For example, the wireless communicator circuitry WC**1** includes signal transmitting circuitry WC**11**, signal receiving circuitry WC**12**, and antenna circuitry WC**13**. The signal transmitting circuitry WC**11** is electrically connected to the antenna circuitry WC**13**. The signal receiving circuitry WC**12** is electrically connected to the antenna circuitry WC**13**.

[0076] The wireless communicator circuitry WC**1** is configured to transmit wireless signals via the antenna circuitry WC**13**. The wireless communicator circuitry WC**1** is configured to superimpose digital signals on carrier wave using a predetermined wireless communication protocol to wirelessly transmit signals. In the present embodiment, the wireless communicator circuitry WC**1** is configured to encrypt signals using a cryptographic key to generate encrypted wireless signals.

[0077] The wireless communicator circuitry WC**1** is configured to receive wireless signals via the antenna circuitry WC**13**. In the present embodiment, the wireless communicator circuitry WC**1** is configured to decode the wireless signals to recognize signals transmitted from other wireless communicators. The wireless communicator circuitry WC**1** is configured to decrypt the wireless signals using the cryptographic key.

[0078] The wireless communicator circuitry WC**1** includes a signal amplifier WC**14**. The signal amplifier WC**14** is coupled to the signal transmitting circuitry WC**11**, the signal receiving circuitry WC**12**, and the antenna circuitry WC**13**. The signal amplifier WC**14** is configured to selectively amplify the signals of the antenna circuitry WC**13**. The signal amplifier WC**14** can be controlled by

the electronic controller circuitry EC**1**. The electronic controller circuitry EC**1** can be configured to control the signal amplifier WC**14** such that the signal amplifier WC**14** operates in a low-power or high-power consumption state.

[0079] The communicator circuitry CC**1** can include wired communicator circuitry and a cable connector. The wired communicator circuitry can be electrically connected to the electronic controller circuitry EC**1**. The cable connector can be electrically connected to the wired communicator circuitry. The wired communicator circuitry can be configured to communicate with another wired communicator circuitry via the cable connector and an electric cable connected to the cable connector.

[0080] The wired communicator circuitry can be configured to communicate with another wired communicator circuitry using power line communication (PLC) technology. For example, the electric cable includes a ground line and a voltage line that are detachably connected to a serial bus that is formed by communication interfaces. The wired communicator circuitry can be configured to communicate with another wired communication circuitry through the voltage line using the PLC technology. Since the PLC technology has been known, it will not be described in detail here for the sake of brevity.

[0081] In the present embodiment, the electric component includes a user interface ED**1** and a display ED**2**. The user interface ED**1** is configured to receive a user input U**1**. The display ED**2** is configured to display information relating to at least one of the electric device ED and the human-powered vehicle B. For example, the user input U**1** can indicate at least one of a power-on, a power-off, a start of pairing, an end of pairing, and a change in settings.

[0082] In the present embodiment, the user interface ED**1** includes a touch panel configured to receive the user input U**1**. The touch panel is provided in the display ED**2**. However, the touch panel can be omitted from the user interface ED**1** if needed or desired. The user interface ED**1** can include another type of interface such as a switch or a dial.

[0083] In the present embodiment, the electric device ED includes a power source holder ED**3**. The power source holder ED**3** is configured to detachably and reattachably hold an electric power source ED**4**. The power source holder ED**3** is configured to be electrically connected to the electronic controller circuitry EC**1**, the communicator circuitry CC**1**, and other electronic parts of the electric device ED. The electric power source ED**4** is configured to supply electricity to the electronic controller circuitry EC**1**, the communicator circuitry CC**1**, and other electronic parts of the electric device ED via the power source holder ED**3**. Examples of the electric power source ED**4** includes a primary battery and a secondary battery. The electric device ED can be configured to receive electricity from another electric power source other than the electric power source PS via an electric cable if needed or desired.

[0084] As seen in FIG. **2**, the detection system **10** comprises a load sensor LS. The load sensor LS is configured to obtain load information INF**1** relating to a load applied, while a rider rides the human-powered vehicle B, to the wheel FW and/or RW of the human-powered vehicle B. The electronic controller circuitry EC**1** is configured to obtain, based on the load information INF**1**, motion information INF**2** relating to a motion of the human-powered vehicle B.

[0085] The load information INF**1** includes air pressure information relating to an air pressure of the wheel FW and/or RW. The load sensor LS is configured to obtain the air pressure information. The electronic controller circuitry EC**1** is configured to obtain the motion information INF**2** based on the air pressure information. A change in the air pressure of the wheel FW and/or RW indicates a change in the motion of the human-powered vehicle B. However, the load information INF**1** can include information other than the air pressure information if needed or desired. The load sensor LS can be configured to obtain information other than the air pressure information if needed or desired. The electronic controller circuitry EC**1** can be configured to obtain the motion information INF**2** based on information other than the air pressure information if needed or desired.

[0086] The motion information INF**2** includes a technical level of the rider. The electronic

controller circuitry EC**1** is configured to determine the technical level based on the load information INF**1**.

[0087] In the present embodiment, the technical level includes a level of a standstill technique that the rider maintains balance while the human-powered vehicle B remains stationary or moves only minimal distances. The electronic controller circuitry EC**1** is configured to determine the level of the standstill technique based on the load information INF**1**.

[0088] Furthermore, the technical level includes a level of a neutral technique that the rider absorbs a bump of a road to reduce shocks applied to the wheel FW and/or RW while the rider rides the human-powered vehicle B. The electronic controller circuitry EC**1** is configured to determine the level of the neutral technique based on the load information INF**1**.

[0089] The motion information INF**2** include at least one of a cadence and a vehicle speed of the human-powered vehicle B. The electronic controller circuitry EC**1** is configured to calculate at least one of the cadence and the vehicle speed based on the load information INF**1**.

[0090] The motion information INF**2** can include at least one of the cadence and the vehicle speed of the human-powered vehicle B instead of or in addition to the technical level of the rider. For example, the motion information INF**2** can include both the cadence and the vehicle speed of the human-powered vehicle B. The electronic controller circuitry EC**1** is configured to calculate both the cadence and the vehicle speed based on the load information INF**1**. However, the motion information INF**2** can include only one the cadence and the vehicle speed of the human-powered vehicle B if needed or desired. The electronic controller circuitry EC**1** can be configured to calculate only one of the cadence and the vehicle speed based on the load information INF**1** if needed or desired.

[0091] As seen in FIG. **2**, the load sensor LS includes at least one of a front load sensor LS**1** and a rear load sensor LS**2**. In the present embodiment, the load sensor LS includes the front load sensor LS**1**. The load sensor LS includes the rear load sensor LS**2**. The load information INF**1** includes at least one of front load information INF**11** and rear load information INF**12**.

[0092] The front load sensor LS**1** is configured to obtain the front load information INF**11** relating to a front load applied, while the rider rides the human-powered vehicle B, to the front wheel FW of the human-powered vehicle B. The rear load sensor LS**2** is configured to obtain the rear load information INF**12** relating to a rear load applied, while the rider rides the human-powered vehicle B, to the rear wheel RW of the human-powered vehicle B.

[0093] The front load information INF**11** includes front air pressure information INF**13** relating to a front air pressure of the front wheel FW. The rear load information INF**12** includes rear air pressure information INF**14** relating to a rear air pressure of the rear wheel RW. The rear load sensor LS**2** is configured to obtain the front air pressure information INF**13**. The rear load sensor LS**2** is configured to obtain the rear air pressure information INF**14**.

[0094] As seen in FIG. **1**, the front load sensor LS**1** is attached to the front wheel FW to detect an air pressure of the front wheel FW. The rear load sensor LS**2** is attached to the rear wheel RW to detect an air pressure of the rear wheel RW. For example, the front load sensor LS**1** is configured to be at least partially provided in a tube of the front wheel FW. The rear load sensor LS**2** is configured to be at least partially provided in a tube of the rear wheel RW.

[0095] As seen in FIG. **2**, the front load sensor LS**1** includes a detector LS**11**. The detector LS**11** is configured to detect force applied to the front load sensor LS**1**. The force applied to the front load sensor LS**1** includes an air pressure of the front wheel FW. The detector LS**11** includes a strain gauge LS**11**A configured to convert deformation of the strain gauge LS**11**A into a resistance value of the strain gauge LS**11**A. The strain gauge LS**11**A is configured to be deformable in response to the force applied to the detector LS**11**. The structure of the detector LS**11** is not limited to the strain gauge LS**11**A. For example, the detector LS**11** can include a piezoelectric element configured to convert deformation of the piezoelectric element into electricity.

[0096] The detector LS**11** includes an output circuit LS**11**B. The output circuit LS**11**B is configured

to convert the resistance value of the strain gauge LS**11**A into a voltage indicating the force applied to the front load sensor LS**1**. The output circuit LS**11**B is electrically connected to the strain gauge LS**11**A. The electronic controller circuitry is electrically connected to the detector LS**11**. The electronic controller circuitry is configured to generate an input signal in response to the output of the detector LS**11**.

[0097] As seen in FIG. **2**, the front load sensor LS**1** comprises electronic controller circuitry EC**2**. The front load sensor LS**1** comprises communicator circuitry CC**2**. Examples of the electric device ED includes a smartphone, a tablet computer, a personal computer, a wearable device, and a cycle computer. Examples of the wearable device include a watch, a bracelet, a ring, a necklace, a belt, a helmet, a belt, and a device attachable to these items.

[0098] The electronic controller circuitry EC**2** is electrically connected to the communicator circuitry CC**2**. The communicator circuitry CC**2** is configured to communicate with another communication device such as the communicator circuitry CC**1** of the electric device ED. The electronic controller circuitry EC**2** is electrically connected to the communicator circuitry CC**2** to control the communicator circuitry CC**2**.

[0099] The electronic controller circuitry EC**2** includes a processor EC**21** and a memory EC**22**. The front load sensor LS**1** includes a circuit board EC**23** and a system bus EC**24**. The communicator circuitry CC**2** and the electronic controller circuitry EC**2** are electrically mounted on the circuit board EC**23**. The electronic controller circuitry EC**2** is coupled to the communicator circuitry CC**2**. The processor EC**21** and the memory EC**22** are electrically mounted on the circuit board EC**23**. The processor EC**21** is coupled to the memory EC**22**. The memory EC**22** is coupled to the processor EC**21**. The processor EC**21** is electrically connected to the memory EC**22** via the circuit board EC**23** and the system bus EC**24**. The memory EC**22** is electrically connected to the processor EC**21** via the circuit board EC**23** and the system bus EC**24**. For example, the electronic controller circuitry EC**2** includes a semiconductor. The processor EC**21** includes a semiconductor. The memory EC**22** includes a semiconductor. However, the electronic controller circuitry EC**2** can be free of a semiconductor if needed or desired. The processor EC**21** can be free of a semiconductor if needed or desired. The memory EC**22** can be free of a semiconductor if needed or desired.

[0100] For example, the processor EC**21** includes at least one of a central processing unit (CPU), a micro processing unit (MPU), a graphics processing unit (GPU), and a memory controller. The memory EC**22** is electrically connected to the processor EC**21**. For example, the memory EC**22** includes at least one of a volatile memory and a non-volatile memory. Examples of the volatile memory include a random-access memory (RAM) and a dynamic random-access memory (DRAM). Examples of the non-volatile memory include a read only memory (ROM), an electrically erasable programmable ROM (EEPROM), and a magnetic disc. The memory EC**22** includes storage areas each having an address. The processor EC**21** is configured to control the memory EC**22** to store data in the storage areas of the memory EC**22** and reads data from the storage areas of the memory EC**22**. The processor EC**21** can also be referred to as a hardware processor EC**21** or a processor circuit or circuitry EC**21**. The memory EC**22** can also be referred to as a hardware memory EC**22** or a memory circuit or circuitry EC**22**. The memory EC**22** can also be referred to as a non-transitory computer-readable storage medium EC**22**. Namely, the electronic controller circuitry EC**2** includes the non-transitory computer-readable storage medium EC**22**.

[0101] The electronic controller circuitry EC**2** is configured to execute at least one control algorithm of the front load sensor LS**1**. For example, the electronic controller circuitry EC**2** is programed to execute at least one control algorithm of the front load sensor LS**1**. The memory EC**22** stores at least one program including at least one program instruction. The at least one program is read into the processor EC**21**, and thereby the at least one control algorithm of the front load sensor LS**1** is executed based on the at least one program.

[0102] The structure of the electronic controller circuitry EC**2** is not limited to the above structure. The structure of the electronic controller circuitry EC**2** is not limited to the processor EC**21** and the

memory EC**22**. The electronic controller circuitry EC**2** can be realized by hardware alone or a combination of hardware and software. In the present embodiment, the processor EC**21** and the memory EC**22** are integrated as a single chip such as an application specific integrated circuit (ASIC) or a field programmable gate array (FPGA). However, the processor EC**21** and the memory EC**22** can be separate chips if needed or desired. The electronic controller circuitry EC**2** can include the processor EC**21**, the memory EC**22**, the circuit board EC**23**, and the system bus EC**24** if needed or desired.

[0103] The electronic controller circuitry EC**2** can include at least two electronic controller circuits which are separately provided. The at least one control algorithm of the front load sensor LS**1** can be executed by the at least two electronic controller circuits if needed or desired. The electronic controller circuitry EC**2** can include at least two processors which are separately provided. The electronic controller circuitry EC**2** can include at least two memories which are separately provided. The at least one control algorithm of the front load sensor LS**1** can be executed by the at least two processors if needed or desired. The at least one control algorithm of the front load sensor LS**1** can be stored in the at least two memories if needed or desired. The electronic controller circuitry EC**2** can include at least two circuit boards which are separately provided if needed or desired. The electronic controller circuitry EC**2** can include at least two system buses which are separately provided if needed or desired.

[0104] The communicator circuitry CC**2** is electrically mounted on the circuit board EC**23**. The communicator circuitry CC**2** is electrically connected to the processor EC**21** and the memory EC**22** with the circuit board EC**23** and the system bus EC**24**.

[0105] The communicator circuitry CC**2** includes wireless communicator circuitry WC**2**. The wireless communicator circuitry WC**2** is configured to wirelessly communicate with another wireless communicator circuitry such as the wireless communicator circuitry WC**1** of the electric device ED. For example, the wireless communicator circuitry WC**2** includes signal transmitting circuitry WC**21**, signal receiving circuitry WC**22**, and antenna circuitry WC**23**. The signal transmitting circuitry WC**21** is electrically connected to the antenna circuitry WC**23**. The signal receiving circuitry WC**22** is electrically connected to the antenna circuitry WC**23**.

[0106] The wireless communicator circuitry WC**2** is configured to transmit wireless signals via the antenna circuitry WC**23**. The wireless communicator circuitry WC**2** is configured to superimpose digital signals on carrier wave using a predetermined wireless communication protocol to wirelessly transmit signals. In the present embodiment, the wireless communicator circuitry WC**2** is configured to encrypt signals using a cryptographic key to generate encrypted wireless signals.

[0107] The wireless communicator circuitry WC**2** is configured to receive wireless signals via the antenna circuitry WC**23**. In the present embodiment, the wireless communicator circuitry WC**2** is configured to decode the wireless signals to recognize signals transmitted from other wireless communicators. The wireless communicator circuitry WC**2** is configured to decrypt the wireless signals using the cryptographic key.

[0108] The wireless communicator circuitry WC**2** includes a signal amplifier WC**24**. The signal amplifier WC**24** is coupled to the signal transmitting circuitry WC**21**, the signal receiving circuitry WC**22**, and the antenna circuitry WC**23**. The signal amplifier WC**24** is configured to selectively amplify the signals of the antenna circuitry WC**23**. The signal amplifier WC**24** can be controlled by the electronic controller circuitry EC**2**. The electronic controller circuitry EC**2** can be configured to control the signal amplifier WC**24** such that the signal amplifier WC**24** operates in a low-power or high-power consumption state.

[0109] The communicator circuitry CC**2** can include wired communicator circuitry and a cable connector. The wired communicator circuitry can be electrically connected to the electronic controller circuitry EC**2**. The cable connector can be electrically connected to the wired communicator circuitry. The wired communicator circuitry can be configured to communicate with another wired communicator circuitry via the cable connector and an electric cable connected to the

cable connector.

[0110] The wired communicator circuitry can be configured to communicate with another wired communicator circuitry using power line communication (PLC) technology. For example, the electric cable includes a ground line and a voltage line that are detachably connected to a serial bus that is formed by communication interfaces. The wired communicator circuitry can be configured to communicate with another wired communication circuitry through the voltage line using the PLC technology. Since the PLC technology has been known, it will not be described in detail here for the sake of brevity.

[0111] In the present embodiment, the electric component includes a user interface LS**15** and an indicator LS**16**. The user interface LS**15** is configured to receive a user input U**2**. The indicator LS**16** is configured to indicate information relating to at least one of the front load sensor LS**1** and the human-powered vehicle B. For example, the user input U**2** can indicate at least one of a power-on, a power-off, a start of pairing, an end of pairing, and a change in settings. The user interface LS**15** includes a switch configured to receive the user input U**2**. The user interface LS**15** can include another type of interface such as a touch panel or a dial.

[0112] In the present embodiment, the electric device ED includes a power source holder LS**13**. The power source holder LS**13** is configured to detachably and reattachably hold an electric power source LS**14**. The power source holder LS**13** is configured to be electrically connected to the electronic controller circuitry EC**2**, the communicator circuitry CC**2**, and other electronic parts of the electric device ED. The electric power source LS**14** is configured to supply electricity to the electronic controller circuitry EC**2**, the communicator circuitry CC**2**, and other electronic parts of the electric device ED via the power source holder LS**13**. Examples of the electric power source LS**14** includes a primary battery and a secondary battery.

[0113] As seen in FIG. **2**, the rear load sensor LS**2** includes a detector LS**21**. The detector LS**21** is configured to detect force applied to the rear load sensor LS**2**. The force applied to the rear load sensor LS**2** includes an air pressure of the rear wheel RW. The detector LS**21** includes a strain gauge LS**21**A configured to convert deformation of the strain gauge LS**21**A into a resistance value of the strain gauge LS**21**A. The strain gauge LS**21**A is configured to be deformable in response to the force applied to the detector LS**21**. The structure of the detector LS**21** is not limited to the strain gauge LS**21**A. For example, the detector LS**21** can include a piezoelectric element configured to convert deformation of the piezoelectric element into electricity.

[0114] The detector LS**21** includes an output circuit LS**21**B. The output circuit LS**21**B is configured to convert the resistance value of the strain gauge LS**21**A into a voltage indicating the force applied to the rear load sensor LS**2**. The output circuit LS**21**B is electrically connected to the strain gauge LS**21**A. The electronic controller circuitry is electrically connected to the detector LS**21**. The electronic controller circuitry is configured to generate an input signal in response to the output of the detector LS**21**.

[0115] As seen in FIG. **2**, the rear load sensor LS**2** comprises electronic controller circuitry EC**3**. The rear load sensor LS**2** comprises communicator circuitry CC**3**. Examples of the electric device ED includes a smartphone, a tablet computer, a personal computer, a wearable device, and a cycle computer. Examples of the wearable device include a watch, a bracelet, a ring, a necklace, a belt, a helmet, a belt, and a device attachable to these items.

[0116] The electronic controller circuitry EC**3** is electrically connected to the communicator circuitry CC**3**. The communicator circuitry CC**3** is configured to communicate with another communication device such as the communicator circuitry CC**1** of the electric device ED and the communicator circuitry CC**2** of the front load sensor LS**1**. The electronic controller circuitry EC**3** is electrically connected to the communicator circuitry CC**3** to control the communicator circuitry CC**3**.

[0117] The electronic controller circuitry EC**3** includes a processor EC**31** and a memory EC**32**. The rear load sensor LS**2** includes a circuit board EC**33** and a system bus EC**34**. The communicator

circuitry CC**3** and the electronic controller circuitry EC**3** are electrically mounted on the circuit board EC**33**. The electronic controller circuitry EC**3** is coupled to the communicator circuitry CC**3**. The processor EC**31** and the memory EC**32** are electrically mounted on the circuit board EC**33**. The processor EC**31** is coupled to the memory EC**32**. The memory EC**32** is coupled to the processor EC**31**. The processor EC**31** is electrically connected to the memory EC**32** via the circuit board EC**33** and the system bus EC**34**. The memory EC**32** is electrically connected to the processor EC**31** via the circuit board EC**33** and the system bus EC**34**. For example, the electronic controller circuitry EC**3** includes a semiconductor. The processor EC**31** includes a semiconductor. The memory EC**32** includes a semiconductor. However, the electronic controller circuitry EC**3** can be free of a semiconductor if needed or desired. The processor EC**31** can be free of a semiconductor if needed or desired. The memory EC**32** can be free of a semiconductor if needed or desired.

[0118] For example, the processor EC**31** includes at least one of a central processing unit (CPU), a micro processing unit (MPU), a graphics processing unit (GPU), and a memory controller. The memory EC**32** is electrically connected to the processor EC**31**. For example, the memory EC**32** includes at least one of a volatile memory and a non-volatile memory. Examples of the volatile memory include a random-access memory (RAM) and a dynamic random-access memory (DRAM). Examples of the non-volatile memory include a read only memory (ROM), an electrically erasable programmable ROM (EEPROM), and a magnetic disc. The memory EC**32** includes storage areas each having an address. The processor EC**31** is configured to control the memory EC**32** to store data in the storage areas of the memory EC**32** and reads data from the storage areas of the memory EC**32**. The processor EC**31** can also be referred to as a hardware processor EC**31** or a processor circuit or circuitry EC**31**. The memory EC**32** can also be referred to as a hardware memory EC**32** or a memory circuit or circuitry EC**32**. The memory EC**32** can also be referred to as a non-transitory computer-readable storage medium EC**32**. Namely, the electronic controller circuitry EC**3** includes the non-transitory computer-readable storage medium EC**32**.

[0119] The electronic controller circuitry EC**3** is configured to execute at least one control algorithm of the rear load sensor LS**2**. For example, the electronic controller circuitry EC**3** is programed to execute at least one control algorithm of the rear load sensor LS**2**. The memory EC**32** stores at least one program including at least one program instruction. The at least one program is read into the processor EC**31**, and thereby the at least one control algorithm of the rear load sensor LS**2** is executed based on the at least one program.

[0120] The structure of the electronic controller circuitry EC**3** is not limited to the above structure. The structure of the electronic controller circuitry EC**3** is not limited to the processor EC**31** and the memory EC**32**. The electronic controller circuitry EC**3** can be realized by hardware alone or a combination of hardware and software. In the present embodiment, the processor EC**31** and the memory EC**32** are integrated as a single chip such as an application specific integrated circuit (ASIC) or a field programmable gate array (FPGA). However, the processor EC**31** and the memory EC**32** can be separate chips if needed or desired. The electronic controller circuitry EC**3** can include the processor EC**31**, the memory EC**32**, the circuit board EC**33**, and the system bus EC**34** if needed or desired.

[0121] The electronic controller circuitry EC**3** can include at least two electronic controller circuits which are separately provided. The at least one control algorithm of the rear load sensor LS**2** can be executed by the at least two electronic controller circuits if needed or desired. The electronic controller circuitry EC**3** can include at least two processors which are separately provided. The electronic controller circuitry EC**3** can include at least two memories which are separately provided. The at least one control algorithm of the rear load sensor LS**2** can be executed by the at least two processors if needed or desired. The at least one control algorithm of the rear load sensor LS**2** can be stored in the at least two memories if needed or desired. The electronic controller circuitry EC**3** can include at least two circuit boards which are separately provided if needed or desired. The electronic controller circuitry EC**3** can include at least two system buses which are

separately provided if needed or desired.

[0122] The communicator circuitry CC**3** is electrically mounted on the circuit board EC**33**. The communicator circuitry CC**3** is electrically connected to the processor EC**31** and the memory EC**32** with the circuit board EC**33** and the system bus EC**34**.

[0123] The communicator circuitry CC**3** includes wireless communicator circuitry WC**3**. The wireless communicator circuitry WC**3** is configured to wirelessly communicate with another wireless communicator circuitry. For example, the wireless communicator circuitry WC**3** includes signal transmitting circuitry WC**31**, signal receiving circuitry WC**32**, and antenna circuitry WC**33**. The signal transmitting circuitry WC**31** is electrically connected to the antenna circuitry WC**33**. The signal receiving circuitry WC**32** is electrically connected to the antenna circuitry WC**33**.

[0124] The wireless communicator circuitry WC**3** is configured to transmit wireless signals via the antenna circuitry WC**33**. The wireless communicator circuitry WC**3** is configured to superimpose digital signals on carrier wave using a predetermined wireless communication protocol to wirelessly transmit signals. In the present embodiment, the wireless communicator circuitry WC**3** is configured to encrypt signals using a cryptographic key to generate encrypted wireless signals.

[0125] The wireless communicator circuitry WC**3** is configured to receive wireless signals via the antenna circuitry WC**33**. In the present embodiment, the wireless communicator circuitry WC**3** is configured to decode the wireless signals to recognize signals transmitted from other wireless communicators. The wireless communicator circuitry WC**3** is configured to decrypt the wireless signals using the cryptographic key.

[0126] The wireless communicator circuitry WC**3** includes a signal amplifier WC**34**. The signal amplifier WC**34** is coupled to the signal transmitting circuitry WC**31**, the signal receiving circuitry WC**32**, and the antenna circuitry WC**33**. The signal amplifier WC**34** is configured to selectively amplify the signals of the antenna circuitry WC**33**. The signal amplifier WC**34** can be controlled by the electronic controller circuitry EC**3**. The electronic controller circuitry EC**3** can be configured to control the signal amplifier WC**34** such that the signal amplifier WC**34** operates in a low-power or high-power consumption state.

[0127] The communicator circuitry CC**3** can include wired communicator circuitry and a cable connector. The wired communicator circuitry can be electrically connected to the electronic controller circuitry EC**3**. The cable connector can be electrically connected to the wired communicator circuitry. The wired communicator circuitry can be configured to communicate with another wired communicator circuitry via the cable connector and an electric cable connected to the cable connector.

[0128] The wired communicator circuitry can be configured to communicate with another wired communicator circuitry using power line communication (PLC) technology. For example, the electric cable includes a ground line and a voltage line that are detachably connected to a serial bus that is formed by communication interfaces. The wired communicator circuitry can be configured to communicate with another wired communication circuitry through the voltage line using the PLC technology. Since the PLC technology has been known, it will not be described in detail here for the sake of brevity.

[0129] In the present embodiment, the electric component includes a user interface LS**25** and an indicator LS**26**. The user interface LS**25** is configured to receive a user input U**2**. The indicator LS**26** is configured to indicate information relating to at least one of the rear load sensor LS**2** and the human-powered vehicle B. For example, the user input U**2** can indicate at least one of a power-on, a power-off, a start of pairing, an end of pairing, and a change in settings. The user interface LS**25** includes a switch configured to receive the user input U**2**. The user interface LS**25** can include another type of interface such as a touch panel or a dial.

[0130] In the present embodiment, the electric device ED includes a power source holder LS**23**. The power source holder LS**23** is configured to detachably and reattachably hold an electric power source LS**24**. The power source holder LS**23** is configured to be electrically connected to the

electronic controller circuitry EC**3**, the communicator circuitry CC**3**, and other electronic parts of the electric device ED. The electric power source LS**24** is configured to supply electricity to the electronic controller circuitry EC**3**, the communicator circuitry CC**3**, and other electronic parts of the electric device ED via the power source holder LS**23**. Examples of the electric power source LS**24** includes a primary battery and a secondary battery.

[0131] As seen in FIG. **2**, the load sensor LS is configured to obtain the load information INF**1** at regular intervals. The load sensor LS is configured to wirelessly transmit the load information INF**1** to the electric device ED at intervals. For example, the front load sensor LS**1** is configured to wirelessly obtain the front load information INF**11** at intervals. The front load sensor LS**1** is configured to wirelessly transmit the front load information INF**11** to the electric device ED at intervals via the wireless communicator circuitry WC**2**. The rear load sensor LS**2** is configured to obtain the rear load information INF**12** at intervals. The rear load sensor LS**2** is configured to wirelessly transmit the rear load information INF**12** to the electric device ED at intervals via the wireless communicator circuitry WC**3**.

[0132] The electric device ED is configured to wirelessly receive the load information INF**1** from the load sensor LS at intervals. For example, the electric device ED is configured to wirelessly receive the front load information INF**11** from the front load sensor LS**1** via the wireless communicator circuitry WC**1** at intervals. The electric device ED is configured to wirelessly receive the front air pressure information INF**13** from the front load sensor LS**1** via the wireless communicator circuitry WC**1** at intervals. The electric device ED is configured to wirelessly receive the rear load information INF**12** from the rear load sensor LS**2** via the wireless communicator circuitry WC**1** at intervals. The electric device ED is configured to wirelessly receive the rear air pressure information INF**14** from the rear load sensor LS**2** via the wireless communicator circuitry WC**1** at intervals.

[0133] The electronic controller circuitry EC**1** is configured to store the load information INF**1** received at intervals in the memory EC**12**. The electronic controller circuitry EC**1** is configured to store the front load information INF**11** received at intervals in the memory EC**12**. The electronic controller circuitry EC**1** is configured to store the front air pressure information INF**13** received at intervals in the memory EC**12**. The electronic controller circuitry EC**1** is configured to store the rear load information INF**12** received at intervals in the memory EC**12**. The electronic controller circuitry EC**1** is configured to store the rear air pressure information INF**14** received at intervals in the memory EC**12**.

[0134] The electronic controller circuitry EC**1** is configured to calculate a load difference between the front load information INF**11** and the rear load information INF**12** at intervals. The electronic controller circuitry EC**1** is configured to subtract the rear load information INF**12** from the front load information INF**11** at intervals to calculate the load difference. For example, the electronic controller circuitry EC**1** is configured to subtract the rear air pressure information INF**14** from the front air pressure information INF**13** at intervals to calculate the load difference. In a case where the front air pressure information INF**13** and the rear air pressure information INF**14** indicate the air pressure of the front wheel FW and the air pressure of the rear wheel RW, the electronic controller circuitry EC**1** is configured to subtract the air pressure of the wheel RW from the air pressure of the wheel FW at intervals to calculate the load difference. Thus, the difference between the air pressure of the front wheel FW and the air pressure of the rear wheel RW indicates where the center of the gravity of the human-powered vehicle B and the rider is located in a neutral position, on a front side relative to the neutral position, or on a rear side relative to the neutral position.

[0135] The electronic controller circuitry EC**1** is configured to store the load difference in the memory EC**12** at intervals. The electronic controller circuitry EC**1** is configured to store, in the memory EC**12**, at least two load differences calculated by the electronic controller circuitry EC**1** at intervals. The electronic controller circuitry EC**1** is configured to store the total number of the at

least two load differences stored in the memory EC**12**.

[0136] The electronic controller circuitry EC**1** is configured to calculate standard deviation of the load difference. The electronic controller circuitry EC**1** is configured to calculate standard deviation of the load difference at intervals. For example, the electronic controller circuitry EC**1** is configured to calculate an average of the at least two load differences at intervals based on the at least two load differences and the total number of the at least two load differences. The electronic controller circuitry EC**1** is configured to calculate the standard deviation based on the average of the at least two load differences and each of the at least two load differences. The electronic controller circuitry EC**1** is configured to calculate the standard deviation based on the average of the at least two load differences and each of the at least two load differences. The electronic controller circuitry EC**1** is configured to store the standard deviation in the memory EC**12**.

[0137] As seen in FIG. **2**, the electronic controller circuitry EC**1** is configured to determine the technical level based on at least one of the front load information INF**11** and the rear load information INF**12**. The electronic controller circuitry EC**1** is configured to determine the technical level based on at least one of the front air pressure information INF**13** and the rear air pressure information INF**14**. The electronic controller circuitry EC**1** is configured to determine the technical level based on both the front load information INF**11** and the rear load information INF**12**. The electronic controller circuitry EC**1** is configured to determine the technical level based on both the front air pressure information INF**13** and the rear air pressure information INF**14**.

[0138] The electronic controller circuitry EC**1** is configured to determine the technical level based on the load difference between the front load information INF**11** and the rear load information INF**12**. The electronic controller circuitry EC**1** is configured to determine the technical level based on a change in the load difference. The electronic controller circuitry EC**1** is configured to determine the technical level based on the standard deviation. The electronic controller circuitry EC**1** is configured to determine the technical level based on the standard deviation stored in the memory EC**12**. For example, the electronic controller circuitry EC**1** is configured to determine the level of the standstill technique based on the standard deviation.

[0139] The electronic controller circuitry EC**1** is configured to determine the technical level based on a change in the load information INF**1**. The electronic controller circuitry EC**1** is configured to determine the technical level based on at least one of a change in the front load information INF**11** and a change in the rear load information INF**12**. The electronic controller circuitry EC**1** is configured to determine the technical level based on at least one of a change in the front air pressure information INF**13** and a change in the rear air pressure information INF**14**. The electronic controller circuitry EC**1** is configured to determine the technical level based on both the change in the front load information INF**11** and the change in the rear load information INF**12**. The electronic controller circuitry EC**1** is configured to determine the technical level based on both the change in the front air pressure information INF**13** and the change in the rear air pressure information INF**14**. For example, the electronic controller circuitry EC**1** is configured to determine the level of the neutral technique based on both the change in the front air pressure information INF**13** and the change in the rear air pressure information INF**14**.

[0140] The technical level includes a first technical level and a second technical level. The first technical level includes a first level of the standstill technique. The second technical level includes a second level of the standstill technique. Furthermore, the first technical level includes a first level of the neutral technique. The second technical level includes a second level of the neutral technique. The technical level can include at least one additional technical level in addition to the first and second technical levels if needed or desired. The technical level can include the first level of the standstill technique and the second level of the standstill technique if needed or desired. The technical level can include the first level of the neutral technique and the second level of the neutral technique if needed or desired.

[0141] In a case where the technical level include the level of the standstill technique, the

electronic controller circuitry EC**1** uses a first level threshold. The electronic controller circuitry EC**1** is configured to select the first technical level in a case where the standard deviation is less than the first level threshold. The electronic controller circuitry EC**1** is configured to select the second technical level in a case where the standard deviation is greater than the first level threshold. The electronic controller circuitry EC**1** is configured to select the second technical level in a case where the standard deviation is greater than or equal to the first level threshold. The electronic controller circuitry EC**1** can be configured to select the first technical level in a case where the standard deviation is equal to the first level threshold.

[0142] In a case where the technical level include the level of the neutral technique, the electronic controller circuitry EC**1** uses a second level threshold, the electronic controller circuitry EC**1** is configured to select the first technical level in a case where the change in the load information INF**1** is less than the second level threshold. The electronic controller circuitry EC**1** is configured to select the second technical level in a case where the change in the load information INF**1** is greater than the second level threshold. The second level threshold includes a front level threshold and a rear level threshold.

[0143] The electronic controller circuitry EC**1** is configured to select the first technical level in a case where the change in the front load information INF**11** is less than the front level threshold and where the change in the rear load information INF**12** is less than the rear level threshold. For example, the electronic controller circuitry EC**1** is configured to select the first technical level in a case where the change in the front air pressure information INF**13** is less than the front level threshold and where the change in the rear air pressure information INF**14** is less than the rear level threshold.

[0144] The electronic controller circuitry EC**1** is configured to select the second technical level in a case where the change in the front load information INF**11** is greater than or equal to the front level threshold and where the change in the rear load information INF**12** is greater than or equal to the rear level threshold. For example, the electronic controller circuitry EC**1** is configured to select the second technical level in a case where the change in the front air pressure information INF**13** is greater than the front level threshold and where the change in the rear air pressure information INF**14** is greater than the rear level threshold.

[0145] The electronic controller circuitry EC**1** can be configured to select the first technical level in a case where the change in the front load information INF**11** is equal to the front level threshold and where the change in the rear load information INF**12** is equal to the rear level threshold. The electronic controller circuitry EC**1** can be configured to select the first technical level in a case where the change in the front air pressure information INF**13** is equal to the front level threshold and where the change in the rear air pressure information INF**14** is equal to the rear level threshold.

[0146] The electronic controller circuitry EC**1** is configured to calculate at least one of the cadence and the vehicle speed based on the rear load information INF**12**. The electronic controller circuitry EC**1** is configured to calculate at least one of the cadence and the vehicle speed based on the rear air pressure information INF**14**. For example, the electronic controller circuitry EC**1** is configured to calculate both the cadence and the vehicle speed based on the rear load information INF**12**. The electronic controller circuitry EC**1** is configured to calculate both the cadence and the vehicle speed based on the rear air pressure information INF**14**. However, the electronic controller circuitry EC**1** can be configured to calculate only one of the cadence and the vehicle speed based on the rear load information INF**12** if needed or desired. The electronic controller circuitry EC**1** can be configured to calculate only one of the cadence and the vehicle speed based on the rear air pressure information INF**14**.

[0147] The electronic controller circuitry EC**1** is configured to calculate at least one of the cadence and the vehicle speed based on a change in the load information INF**1**. The electronic controller circuitry EC**1** is configured to calculate at least one of the cadence and the vehicle speed based on a change in the rear load information INF**12**. The electronic controller circuitry EC**1** is configured to

calculate at least one of the cadence and the vehicle speed based on a change in the rear air pressure information INF**14**.

[0148] For example, the electronic controller circuitry EC**1** is configured to calculate both the cadence and the vehicle speed based on the change in the load information INF**1**. The electronic controller circuitry EC**1** is configured to calculate both the cadence and the vehicle speed based on the change in the rear load information INF**12**. The electronic controller circuitry EC**1** is configured to calculate both the cadence and the vehicle speed based on the change in the rear air pressure information INF**14**. However, the electronic controller circuitry EC**1** can be configured to calculate only one the cadence and the vehicle speed based on the change in the load information INF**1** if needed or desired. The electronic controller circuitry EC**1** can be configured to calculate only one the cadence and the vehicle speed based on the change in the rear load information INF**12** if needed or desired. The electronic controller circuitry EC**1** can be configured to calculate only one the cadence and the vehicle speed based on the change in the rear air pressure information INF**14** if needed or desired.

[0149] The electronic controller circuitry EC**1** is configured to calculate at least one of the cadence and the vehicle speed based on a total number of peaks of the load information INF**1** per unit time. The electronic controller circuitry EC**1** is configured to calculate at least one of the cadence and the vehicle speed based on a total number of peaks of the rear load information INF**12** per unit time. The electronic controller circuitry EC**1** is configured to calculate at least one of the cadence and the vehicle speed based on a total number of peaks of the rear air pressure information INF**14** per unit time.

[0150] As seen in FIG. **3**, the air pressure AP**2** of the rear wheel RW reaches a peak when pedaling torque applied to the crank CR reaches a peak. For example, the air pressure AP**2** of the rear wheel RW reaches a peak when pedaling torque applied to a right arm of the crank CR reaches a peak. The air pressure AP**2** of the rear wheel RW reaches another peak when pedaling torque applied to a left arm of the crank CR reaches a peak. Thus, the electronic controller circuitry EC**1** is configured to calculate, as the cadence, a half of the total number of peaks of the rear load information INF**12**.

[0151] As seen in FIG. **2**, the electronic controller circuitry EC**1** is configured to calculate the vehicle speed V based on the cadence C, a current gear ratio G, and a circumferential length L of the wheel RW, and the following equation (1). The equation (1) includes the cadence C calculated based on the load information INF**1**. Thus, the electronic controller circuitry EC**1** is configured to calculate the vehicle speed V based on the load information INF**1**.

[00001] $V = C \times G \times L$ (1)

[0152] The electronic controller circuitry EC**1** is configured to obtain the current gear ratio G from the gear changer **12** and store the current gear ratio G in the memory EC**12**. For example, the gear changer **12** includes additional wireless communicator circuitry configured to wirelessly communicate with another wireless communicator circuitry, and the electronic controller circuitry EC**1** wirelessly receives the current gear ratio G from the gear changer **12** at intervals via the wireless communicator circuitry WC**1** and the additional wireless communicator circuitry of the gear changer **12**. The electronic controller circuitry EC**1** is configured to store the circumferential length L in the memory EC**12**.

[0153] The detection method executed by the detection system **10** will be described in detail below referring to FIGS. **4** to **7**. As seen in FIGS. **4** to **7**, the detection method comprises: obtaining the load information INF**1** relating to the load applied, while the rider rides the human-powered vehicle B, to the wheel FW and/or RW of the human-powered vehicle B; and obtaining, based on the load information INF**1**, the motion information INF**2** relating to the motion of the human-powered vehicle B. The computer-readable storage medium EC**12** stores program instructions for causing the electronic controller circuitry EC**1** to execute the detection method.

[0154] As seen in FIG. **4**, in step S**1**, the load information INF**1** is obtained by the load sensor LS.

In step S1A, the front load information INF11 is obtained by the front load sensor LS1. In step S1A, for example, the front air pressure information INF13 is obtained by the front load sensor LS1. In step S1B, the rear load information INF12 is obtained by the rear load sensor LS2. In step S1B, for example, the rear air pressure information INF14 is obtained by the rear load sensor LS2.

[0155] In step S2, the load information INF1 is wirelessly transmitted from the load sensor LS to the electronic controller circuitry EC1 of the electric device ED. In step S2A, the front load information INF11 is wirelessly transmitted from the front load sensor LS1 to the electronic controller circuitry EC1 of the electric device ED. In step S2A, for example, the front air pressure information INF13 is wirelessly transmitted from the front load sensor LS1 to the electronic controller circuitry EC1 of the electric device ED. In step S2B, the rear load information INF12 is wirelessly transmitted from the rear load sensor LS2 to the electronic controller circuitry EC1 of the electric device ED. In step S2B, for example, the rear air pressure information INF14 is wirelessly transmitted from the rear load sensor LS2 to the electronic controller circuitry EC1 of the electric device ED.

[0156] In step S3, the load information INF1 is received by the electronic controller circuitry EC1 of the electric device ED from the load sensor LS.

[0157] In step S3A, the front load information INF11 is received by the electronic controller circuitry EC1 of the electric device ED from the front load sensor LS1. The front load information INF11 is stored in the memory EC12 by the electronic controller circuitry EC1. In step S3A, for example, the front air pressure information INF13 is received by the electronic controller circuitry EC1 of the electric device ED from the front load sensor LS1. The front air pressure information INF13 is stored in the memory EC12 by the electronic controller circuitry EC1.

[0158] In step S3B, the rear load information INF12 is received by the electronic controller circuitry EC1 of the electric device ED from the rear load sensor LS2. The rear load information INF12 is stored in the memory EC12 by the electronic controller circuitry EC1. In step S3B, for example, the rear air pressure information INF14 is received by the electronic controller circuitry EC1 of the electric device ED from the rear load sensor LS2. The rear air pressure information INF14 is stored in the memory EC12 by the electronic controller circuitry EC1.

[0159] As seen in FIG. 5, in step S4, the motion information INF2 is obtained by the electronic controller circuitry EC1 based on the load information INF1. In step S4, the level of the standstill technique is determined by the electronic controller circuitry EC1.

[0160] In step S4A, the standard deviation of the load difference between the front load information INF11 and the rear load information INF12 is calculated by the electronic controller circuitry EC1 based on the front load information INF11 and the rear load information INF12. In step S4A, for example, the standard deviation of the load difference between the front air pressure information INF13 and the rear air pressure information INF14 is calculated by the electronic controller circuitry EC1 based on the front air pressure information INF13 and the rear air pressure information INF14.

[0161] In step S4A, for example, the average of the at least two load differences is calculated by the electronic controller circuitry EC1. The at least two load differences are stored in the memory EC12. In step S4A, the standard deviation of the at least two load differences is calculated by the electronic controller circuitry EC1 based on the average of the at least two load differences and each of the at least two load differences.

[0162] In step S4B, the standard deviation SD is compared with the first level threshold LT1 by the electronic controller circuitry EC1. In steps S4B and S4C, in a case where the standard deviation SD is less than the first level threshold LT1, the first technical level LV11 is selected as the technical level by the electronic controller circuitry EC1. In steps S4B and S4D, in a case where the standard deviation SD is greater than or equal to the first level threshold LT1, the second technical level LV12 is selected as the technical level by the electronic controller circuitry EC1.

[0163] In step S5, the selected technical level is displayed by the display ED2. The first technical

level LV**11** is displayed by the display ED**2** in a case where the first technical level LV**11** has been selected by the electronic controller circuitry EC**1**. The second technical level LV**12** is displayed by the display ED**2** in a case where the second technical level LV**12** has been selected by the electronic controller circuitry EC**1**. Thus, the user can recognize the technical level of the user based on the selected technical level.

[0164] As seen in FIG. **6**, in step S**6**, the motion information INF**2** is obtained by the electronic controller circuitry EC**1** based on the load information INF**1**. In step S**6**, the level of the neutral technique is determined by the electronic controller circuitry EC**1**.

[0165] In step S**6**A, the change in the load information INF**1** is calculated by the electronic controller circuitry EC**1** based on the previous value and the current value of the load information INF**1**. In step S**6**B, the change in the front load information INF**11** is calculated by the electronic controller circuitry EC**1** based on the previous value and the current value of the front load information INF**11**. In step S**6**B, for example, the change in the front air pressure information INF**13** is calculated by the electronic controller circuitry EC**1** based on the previous value and the current value of the front air pressure information INF**13**. In step S**6**C, the change in the rear load information INF**12** is calculated by the electronic controller circuitry EC**1** based on the previous value and the current value of the rear load information INF**12**. In step S**6**C, for example, the change in the rear air pressure information INF**14** is calculated by the electronic controller circuitry EC**1** based on the previous value and the current value of the rear air pressure information INF**14**.

[0166] In step S**6**D, the change P**1** in the front load information INF**11** is compared with the second level threshold LT**2** by the electronic controller circuitry EC**1**. In step S**6**D, for example, the change P**1** in the front air pressure information INF**13** is compared with the second level threshold LT**2** by the electronic controller circuitry EC**1**.

[0167] In steps S**6**D and S**6**E, in a case where the change P**1** in the front load information INF**11** is less than the second level threshold LT**2**, the change P**2** in the rear load information INF**12** is compared with the second level threshold LT**2** by the electronic controller circuitry EC**1**. In step S**6**E, for example, the change P**2** in the rear air pressure information INF**14** is compared with the second level threshold LT**2** by the electronic controller circuitry EC**1**.

[0168] In steps S**6**E and S**6**F, in a case where the change P**2** in the rear load information INF**12** is less than the second level threshold LT**2**, the first technical level LV**21** is selected as the technical level by the electronic controller circuitry EC**1**. In steps S**6**E and S**6**F, for example, in a case where the change P**2** in the rear air pressure information INF**14** is less than the second level threshold LT**2**, the first technical level LV**21** is selected as the technical level by the electronic controller circuitry EC**1**.

[0169] In steps S**6**D, S**6**E, and S**6**G, in a case where at least one of the change P**1** in the front load information INF**11** and the change P**2** in the rear load information INF**12** is greater than or equal to the second level threshold LT**2**, the second technical level LV**22** is selected as the technical level by the electronic controller circuitry EC**1**. In steps S**6**D, S**6**E, and S**6**G, for example, in a case where at least one of the change P**1** in the front air pressure information INF**13** and the change P**2** in the rear air pressure information INF**14** is greater than or equal to the second level threshold LT**2**, the second technical level LV**22** is selected as the technical level by the electronic controller circuitry EC**1**.

[0170] In step S**7**, the selected technical level is displayed by the display ED**2**. The first technical level LV**21** is displayed by the display ED**2** in a case where the first technical level LV**21** has been selected by the electronic controller circuitry EC**1**. The second technical level LV**22** is displayed by the display ED**2** in a case where the second technical level LV**22** has been selected by the electronic controller circuitry EC**1**. Thus, the user can recognize the technical level of the user based on the selected technical level.

[0171] As seen in FIG. **7**, in step S**8**, the motion information INF**2** is obtained by the electronic controller circuitry EC**1** based on the load information INF**1**. In step S**8**, the cadence and the

vehicle speed are obtained by the electronic controller circuitry EC**1** based on the load information INF**1**.

[0172] In step S**8**A, for example, the cadence is calculated by the electronic controller circuitry EC**1** based on the load information INF**1**. For example, the cadence is calculated by the electronic controller circuitry EC**1** based on the rear load information INF**12**. The cadence is calculated by the electronic controller circuitry EC**1** based on the rear air pressure information INF**14**. The cadence can be calculated by the electronic controller circuitry EC**1** based on the front air pressure information INF**13** or both the front air pressure information and the rear air pressure information INF**14**.

[0173] For example, the cadence is calculated by the electronic controller circuitry EC**1** based on the total number of peaks of the load information INF**1** per unit time. The cadence is calculated by the electronic controller circuitry EC**1** based on the total number of peaks of the rear load information INF**12** per unit time. The cadence is calculated by the electronic controller circuitry EC**1** based on the total number of peaks of the rear air pressure information INF**14** per unit time. The half of the total number of peaks of the rear air pressure information INF**14** per unit time is calculated as the cadence by the electronic controller circuitry EC**1**.

[0174] In step S**8**B, the vehicle speed is calculated by the electronic controller circuitry EC**1** based on the load information INF**1**. For example, the vehicle speed is calculated by the electronic controller circuitry EC**1** based on the rear load information INF**12**. The vehicle speed is calculated by the electronic controller circuitry EC**1** based on the rear air pressure information INF**14**.

[0175] For example, the vehicle speed is calculated by the electronic controller circuitry EC**1** based on the cadence calculated based on the rear air pressure information INF**14**. The vehicle speed is calculated by the electronic controller circuitry EC**1** based on the cadence C, the current gear ratio G, the circumferential length L of the rear wheel RW, and the equation (1).

[0176] In step S**9**, the cadence and the vehicle speed are displayed by the display ED**2**. Thus, the user can recognize the cadence and the vehicle speed based on the motion information INF**2** displayed by the display ED**2**. The process returns to step S**1**.

[0177] As seen in FIGS. **4** to **7**, steps S**4** to S**9** are executed to obtain the motion information INF**2**. However, the steps S**4** and S**5** can be omitted from the flowchart depicted in FIGS. **4** to **7** if needed or desired. The steps S**6** and S**7** can be omitted from the flowchart depicted in FIGS. **4** to **7** if needed or desired. The steps S**8** and S**9** can be omitted from the flowchart depicted in FIGS. **4** to **7** if needed or desired.

[0178] In the flowchart depicted in FIGS. **4** to **7**, the steps S**4** to S**7** are executed after receipt of the load information INF**1**. However, the steps S**4** and S**5** can be executed as a separate flowchart after the completion of collecting data of the load information INF**1**. The steps S**6** and S**7** can be executed as a separate flowchart after the completion of collecting data of the load information INF**1**.

[0179] In the present application, the term "comprising" and its derivatives, as used herein, are intended to be open ended terms that specify the presence of the stated features, elements, components, groups, integers, and/or steps, but do not exclude the presence of other unstated features, elements, components, groups, integers and/or steps. This concept also applies to words of similar meaning, for example, the terms "have," "include" and their derivatives.

[0180] The terms "member," "section," "portion," "part," "element," "body" and "structure" when used in the singular can have the dual meaning of a single part or a plurality of parts.

[0181] The ordinal numbers such as "first" and "second" recited in the present application are merely identifiers, but do not have any other meanings, for example, a particular order and the like. Moreover, for example, the term "first element" itself does not imply an existence of "second element," and the term "second element" itself does not imply an existence of "first element."

[0182] The term "pair of," as used herein, can encompass the configuration in which the pair of elements have different shapes or structures from each other in addition to the configuration in

which the pair of elements have the same shapes or structures as each other.

[0183] The terms "a" (or "an"), "one or more" and "at least one" can be used interchangeably herein.

[0184] The phrase "at least one of" as used in this disclosure means "one or more" of a desired choice. For one example, the phrase "at least one of" as used in this disclosure means "only one single choice" or "both of two choices" if the number of its choices is two. For other example, the phrase "at least one of" as used in this disclosure means "only one single choice" or "any combination of equal to or more than two choices" if the number of its choices is equal to or more than three. For instance, the phrase "at least one of A and B" encompasses (1) A alone, (2), B alone, and (3) both A and B. The phrase "at least one of A, B, and C" encompasses (1) A alone, (2), B alone, (3) C alone, (4) both A and B, (5) both B and C, (6) both A and C, and (7) all A, B, and C. In other words, the phrase "at least one of A and B" does not mean "at least one of A and at least one of B" in this disclosure.

[0185] Finally, terms of degree such as "substantially," "about" and "approximately" as used herein mean a reasonable amount of deviation of the modified term such that the end result is not significantly changed. All of numerical values described in the present application can be construed as including the terms such as "substantially," "about" and "approximately."

[0186] Obviously, numerous modifications and variations of the present invention are possible in light of the above teachings. It is therefore to be understood that within the scope of the appended claims, the invention may be practiced otherwise than as specifically described herein.

Claims

1. A detection system comprising: a load sensor configured to obtain load information relating to a load applied, while a rider rides a human-powered vehicle, to a wheel of the human-powered vehicle; and electronic controller circuitry configured to obtain, based on the load information, motion information relating to a motion of the human-powered vehicle.

2. The detection system according to claim 1, wherein the load information includes air pressure information relating to an air pressure of the wheel, the load sensor is configured to obtain the air pressure information, and the electronic controller circuitry is configured to obtain the motion information based on the air pressure information.

3. The detection system according to claim 1, wherein the motion information includes a technical level of the rider, and the electronic controller circuitry is configured to determine the technical level based on the load information.

4. The detection system according to claim 3, wherein the technical level includes a level of a standstill technique that the rider maintains balance while the human-powered vehicle remains stationary or moves only minimal distances, and the electronic controller circuitry is configured to determine the level of the standstill technique based on the load information.

5. The detection system according to claim 3, wherein the technical level includes a level of a neutral technique that the rider absorbs a bump of a road to reduce shocks applied to the wheel while the rider rides the human-powered vehicle, and the electronic controller circuitry is configured to determine the level of the neutral technique based on the load information.

6. The detection system according to claim 3, wherein the load sensor includes a front load sensor and a rear load sensor, the front load sensor is configured to obtain front load information relating to a front load applied, while the rider rides the human-powered vehicle, to a front wheel of the human-powered vehicle, the rear load sensor is configured to obtain rear load information relating to a rear load applied, while the rider rides the human-powered vehicle, to a rear wheel of the human-powered vehicle, and the electronic controller circuitry is configured to determine the technical level based on at least one of the front load information and the rear load information.

7. The detection system according to claim 6, wherein the electronic controller circuitry is

configured to determine the technical level based on a load difference between the front load information and the rear load information.

8. The detection system according to claim 7, wherein the electronic controller circuitry is configured to determine the technical level based on a change in the load difference.

9. The detection system according to claim 8, wherein the electronic controller circuitry is configured to calculate standard deviation of the load difference, and the electronic controller circuitry is configured to determine the technical level based on the standard deviation.

10. The detection system according to claim 9, wherein the technical level includes a first technical level and a second technical level, the electronic controller circuitry is configured to select the first technical level in a case where the standard deviation is less than a first level threshold, and the electronic controller circuitry is configured to select the second technical level in a case where the standard deviation is greater than the first level threshold.

11. The detection system according to claim 3, wherein the electronic controller circuitry is configured to determine the technical level based on a change in the load information.

12. The detection system according to claim 11, wherein the load sensor includes at least one of a front load sensor and a rear load sensor, the front load sensor is configured to obtain front load information relating to a front load applied, while the rider rides the human-powered vehicle, to a front wheel of the human-powered vehicle, the rear load sensor is configured to obtain rear load information relating to a rear load applied, while the rider rides the human-powered vehicle, to a rear wheel of the human-powered vehicle, and the electronic controller circuitry is configured to determine the technical level based on at least one of a change in the front load information, and a change in the rear load information.

13. The detection system according to claim 11, wherein the technical level includes a first technical level and a second technical level, the electronic controller circuitry is configured to select the first technical level in a case where the change in the load information is less than a second level threshold, and the electronic controller circuitry is configured to select the second technical level in a case where the change in the load information is greater than the second level threshold.

14. The detection system according to claim 1, wherein the motion information includes at least one of a cadence and a vehicle speed of the human-powered vehicle, and the electronic controller circuitry is configured to calculate at least one of the cadence and the vehicle speed based on the load information.

15. The detection system according to claim 14, wherein the load sensor includes a rear load sensor configured to obtain rear load information relating to a rear load applied, while the rider rides the human-powered vehicle, to a rear wheel of the human-powered vehicle, and the electronic controller circuitry is configured to calculate at least one of the cadence and the vehicle speed based on the rear load information.

16. The detection system according to claim 15, wherein the rear load information includes rear air pressure information relating to a rear air pressure of the rear wheel, the rear load sensor is configured to obtain the rear air pressure information, and the electronic controller circuitry is configured to calculate at least one of the cadence and the vehicle speed based on the rear air pressure information.

17. The detection system according to claim 14, wherein the electronic controller circuitry is configured to calculate at least one of the cadence and the vehicle speed based on a change in the load information.

18. The detection system according to claim 14, wherein the electronic controller circuitry is configured to calculate at least one of the cadence and the vehicle speed based on a total number of peaks of the load information per unit time.

19. A detection method comprising: obtaining load information relating to a load applied, while a rider rides a human-powered vehicle, to a wheel of the human-powered vehicle; and obtaining,

based on the load information, motion information relating to a motion of the human-powered vehicle.

20. A computer-readable storage medium storing program instructions for causing electronic controller circuitry to execute a detection method comprising: obtaining load information relating to a load applied, while a rider rides a human-powered vehicle, to a wheel of the human-powered vehicle; and obtaining, based on the load information, motion information relating to a motion of the human-powered vehicle.