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Santurbane et al.

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(54) **AUTOMATIC BICYCLE SYSTEM AND USER PROFILE IDENTIFICATION**

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(51) **Int. Cl.**

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B62J 45/414	(2020.01)
B62J 50/22	(2020.01)
B62J 50/25	(2020.01)
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H04L 67/306	(2022.01)

(52) **U.S. Cl.**

CPC ***B62J 45/20*** (2020.02); ***B62J 45/412*** (2020.02); ***B62J 45/414*** (2020.02); ***B62J 50/22*** (2020.02); ***B62J 50/25*** (2020.02); ***H04L 67/12*** (2013.01); ***H04L 67/306*** (2013.01)

(58) **Field of Classification Search**

CPC B62J 45/20; B62J 45/412; B62J 45/414; B62J 50/22; B62J 50/25; H04L 67/12; H04L 67/306

See application file for complete search history.

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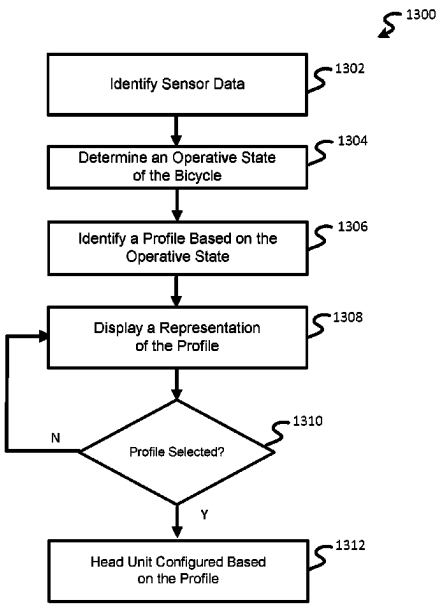
Primary Examiner — Mohamed Barakat

(57) **ABSTRACT**

A controller device usable with a bicycle includes a communication interface configured to receive component data from another controller device of the bicycle. The communication interface is configured to receive auxiliary data from outside the bicycle. The controller device includes a processor in communication with the communication interface. The processor being is configured to determine a location of the bicycle based on the auxiliary data, compare the received component data to a plurality of predetermined component datasets for a plurality of bicycles, respectively, and identify at least one bicycle of the plurality of bicycles based on the comparison and the determined location of the bicycle. The at least one bicycle includes the bicycle. The controller device includes a display in communication with the processor. The display is configured to display a representation for each bicycle of the at least one identified bicycle.

12 Claims, 19 Drawing Sheets



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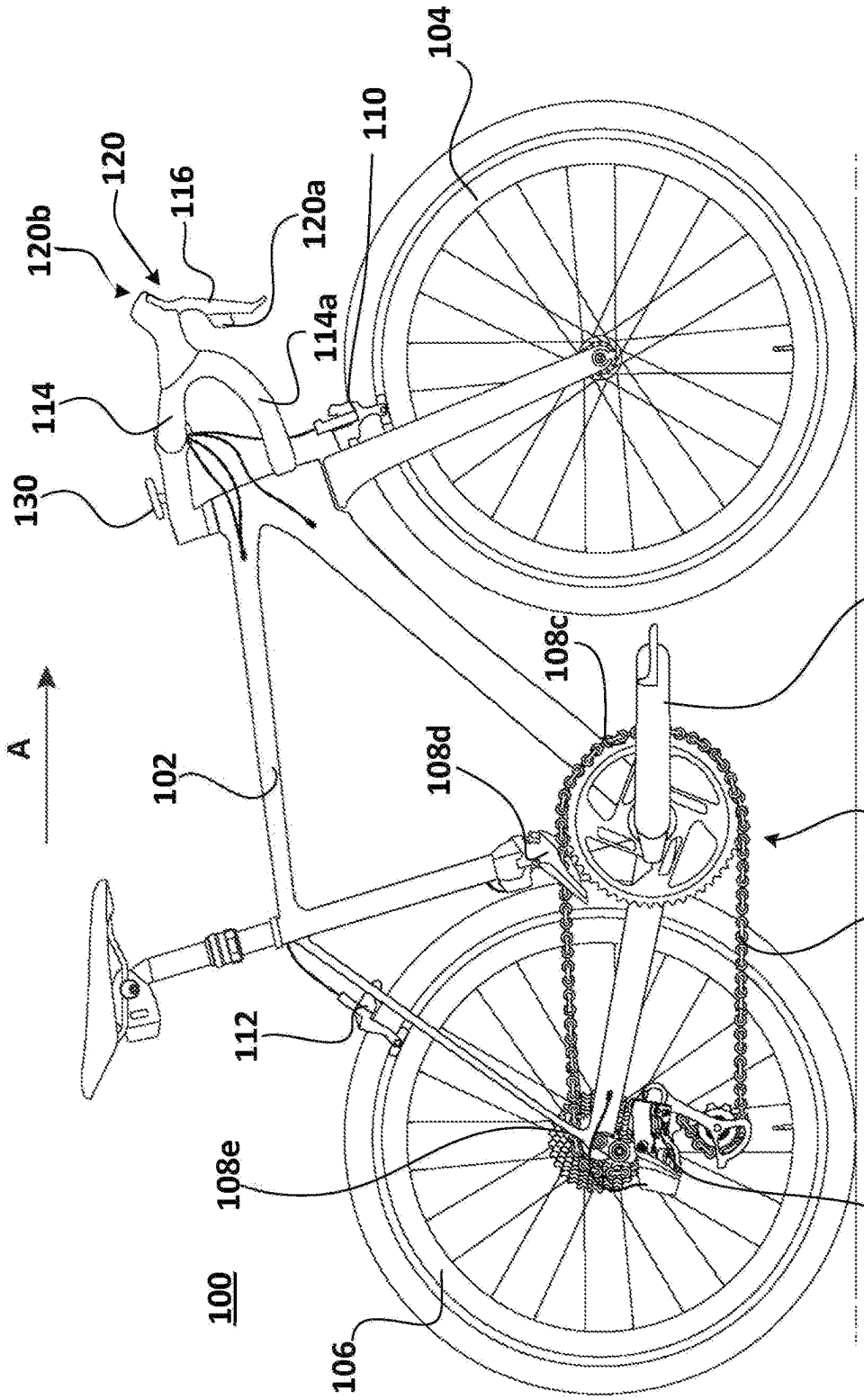
104
110
120
116
120a
120b
114a
114
130
A
102
108d
108c
108b
108
108a
112
108e
108f
100
106

FIG. 1A

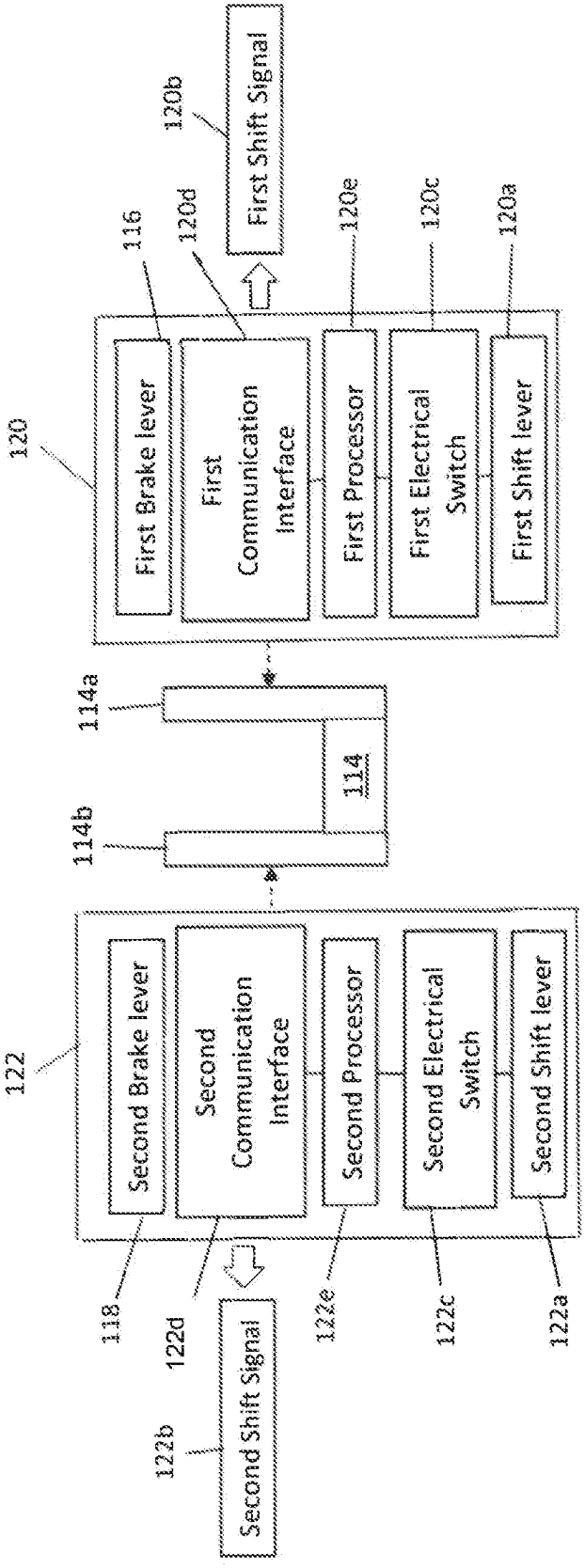
120
First Brake lever
First Communication Interface
First Processor
First Electrical Switch
First Shift lever
First Shift Signal
116
120d
120b
120e
120c
120a
114a
114
114b
122
Second Brake lever
Second Communication Interface
Second Processor
Second Electrical Switch
Second Shift lever
Second Shift Signal
118
122d
122e
122c
122a
122b

FIG. 1B

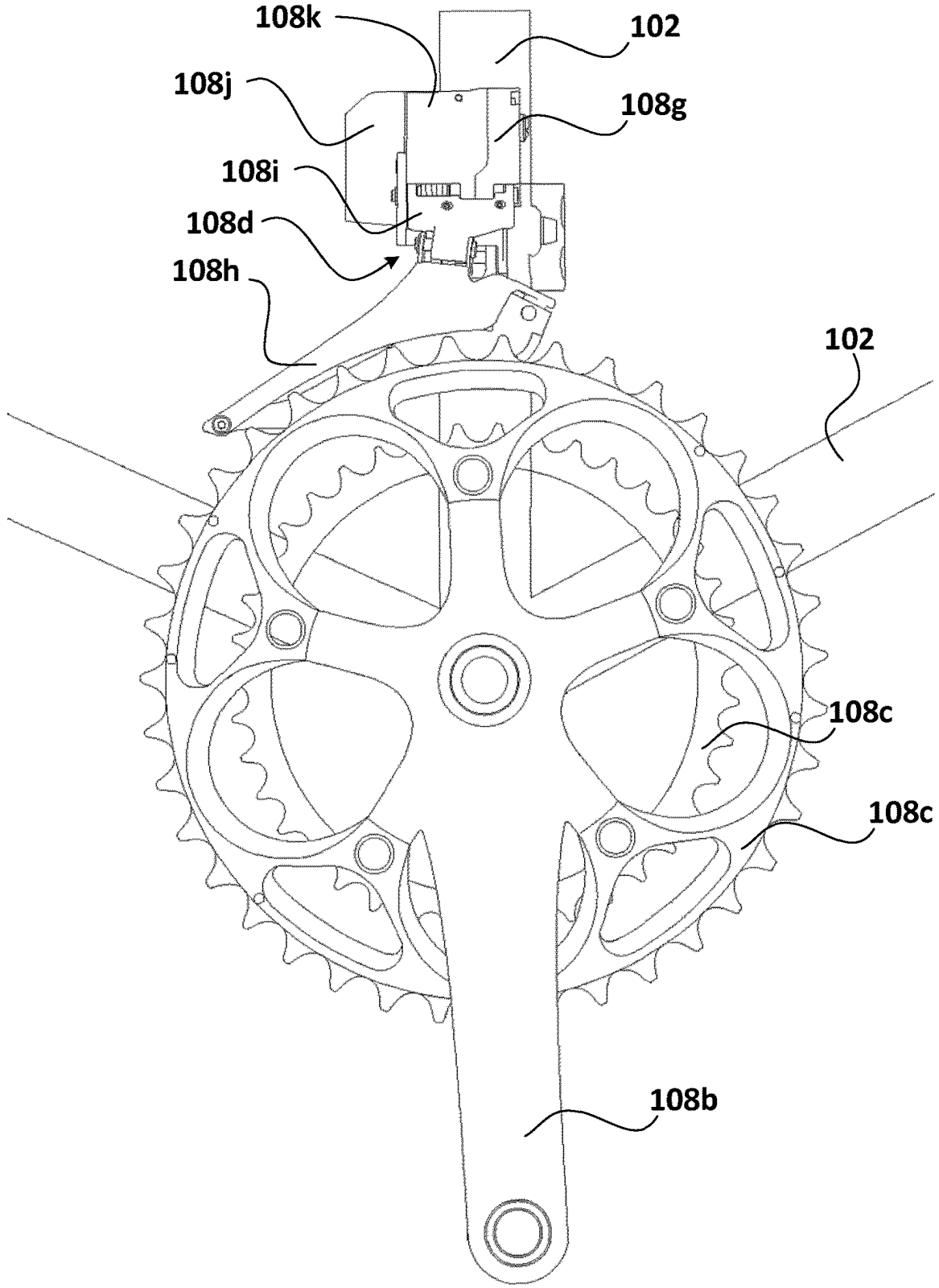

FIG. 1C

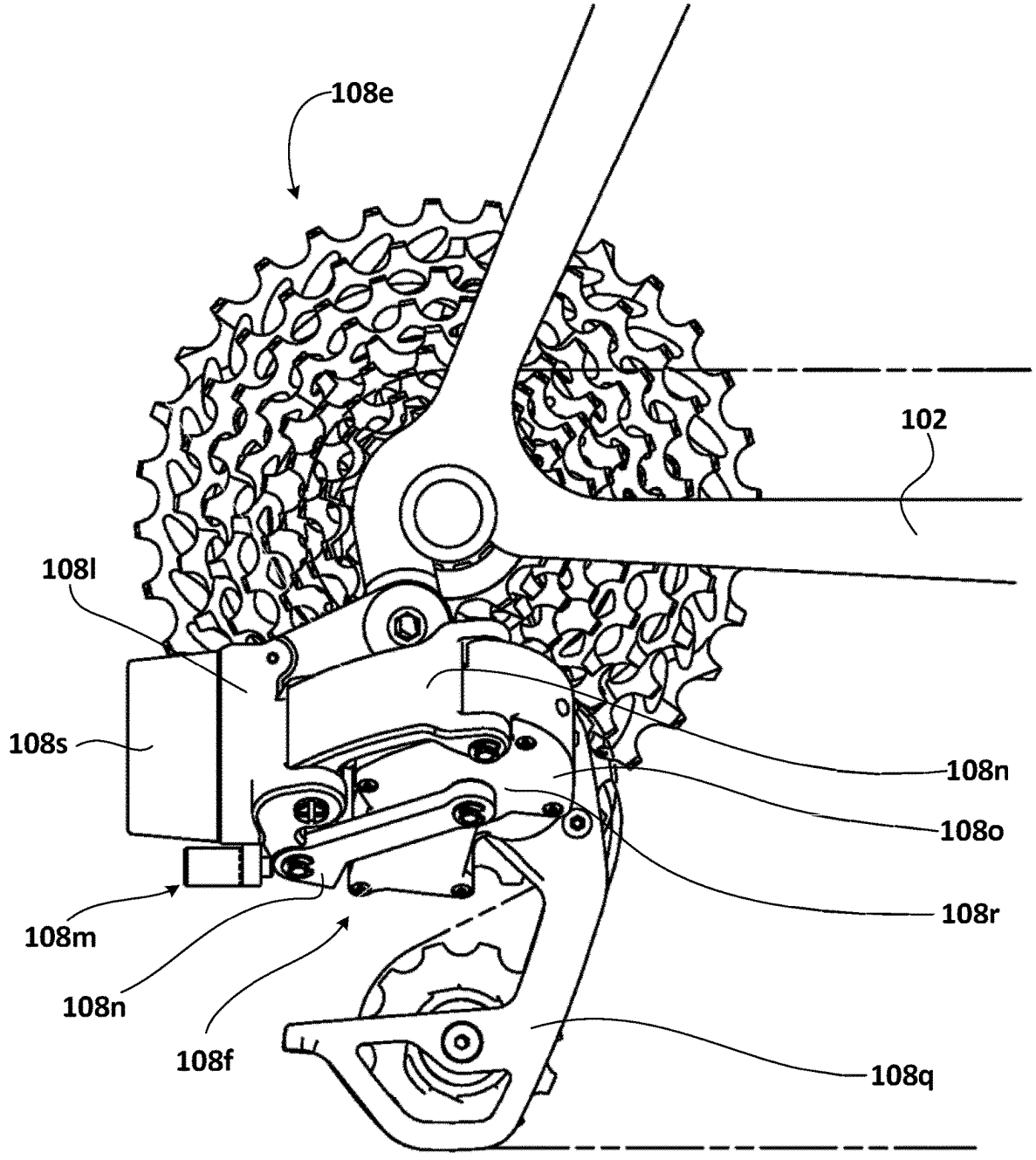

FIG. 1D

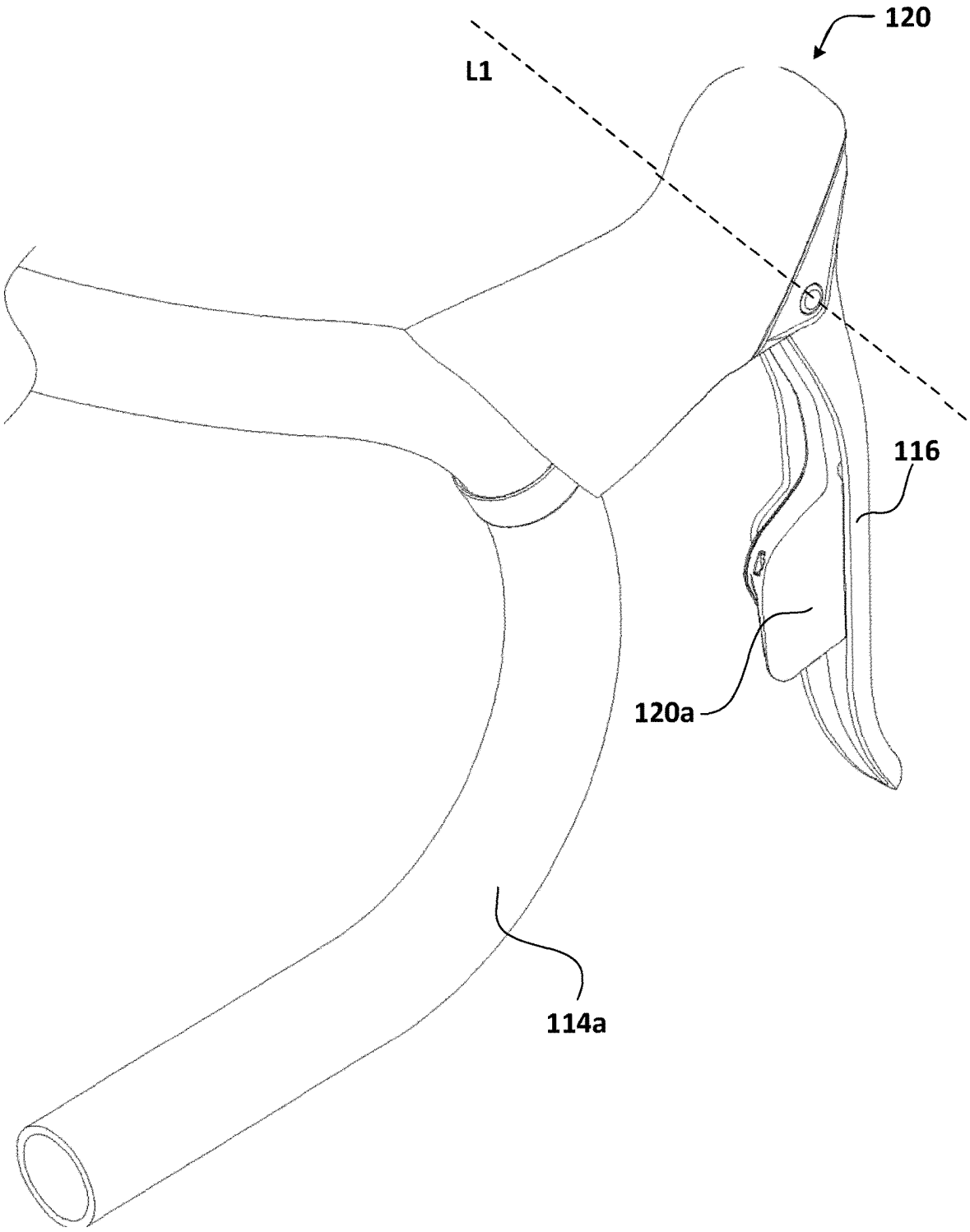

FIG. 1E

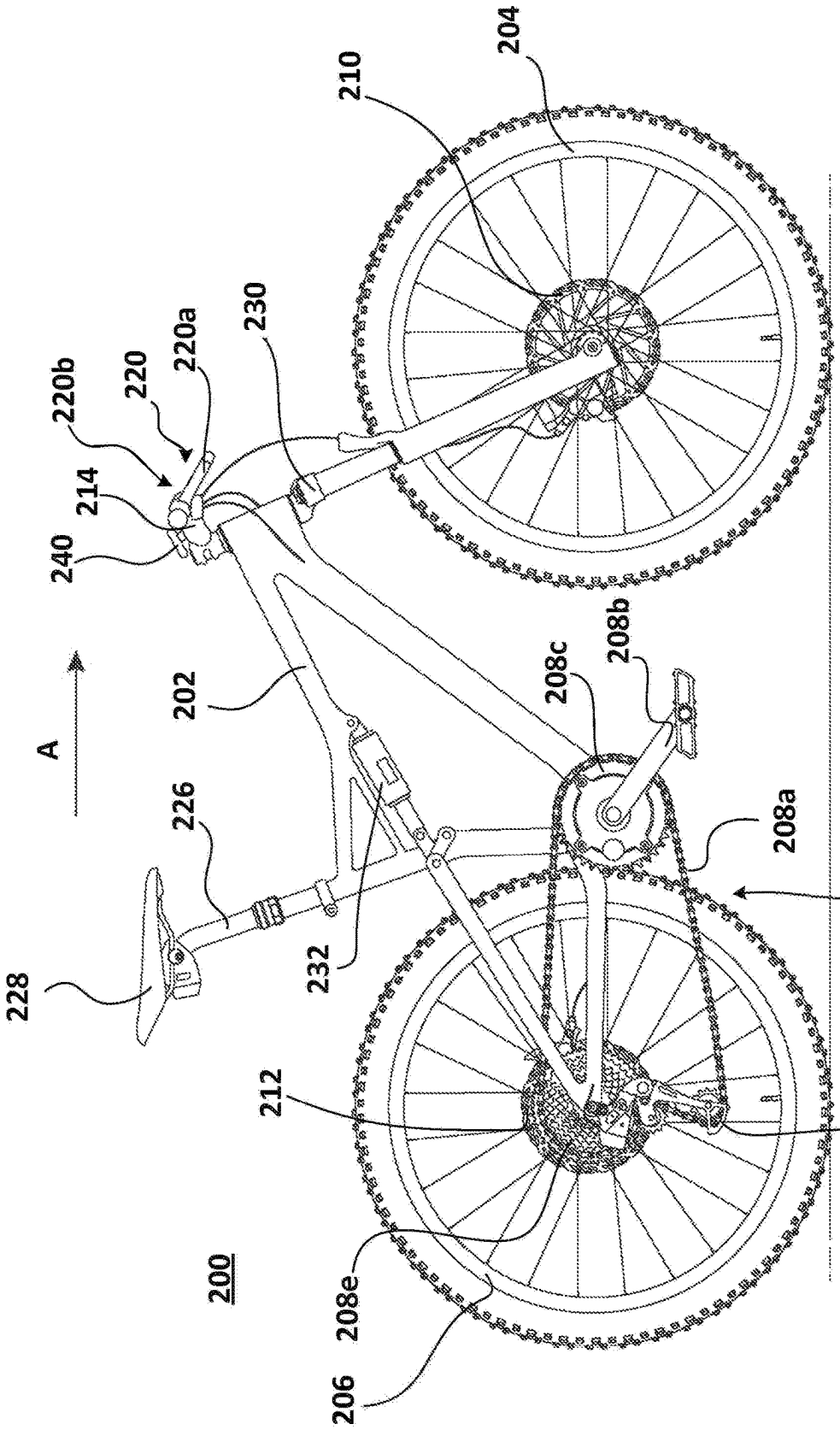
200
202
204
206
208
208a
208b
208c
208e
208f
210
212
214
220
220a
220b
226
228
230
232
240
A

FIG. 2A

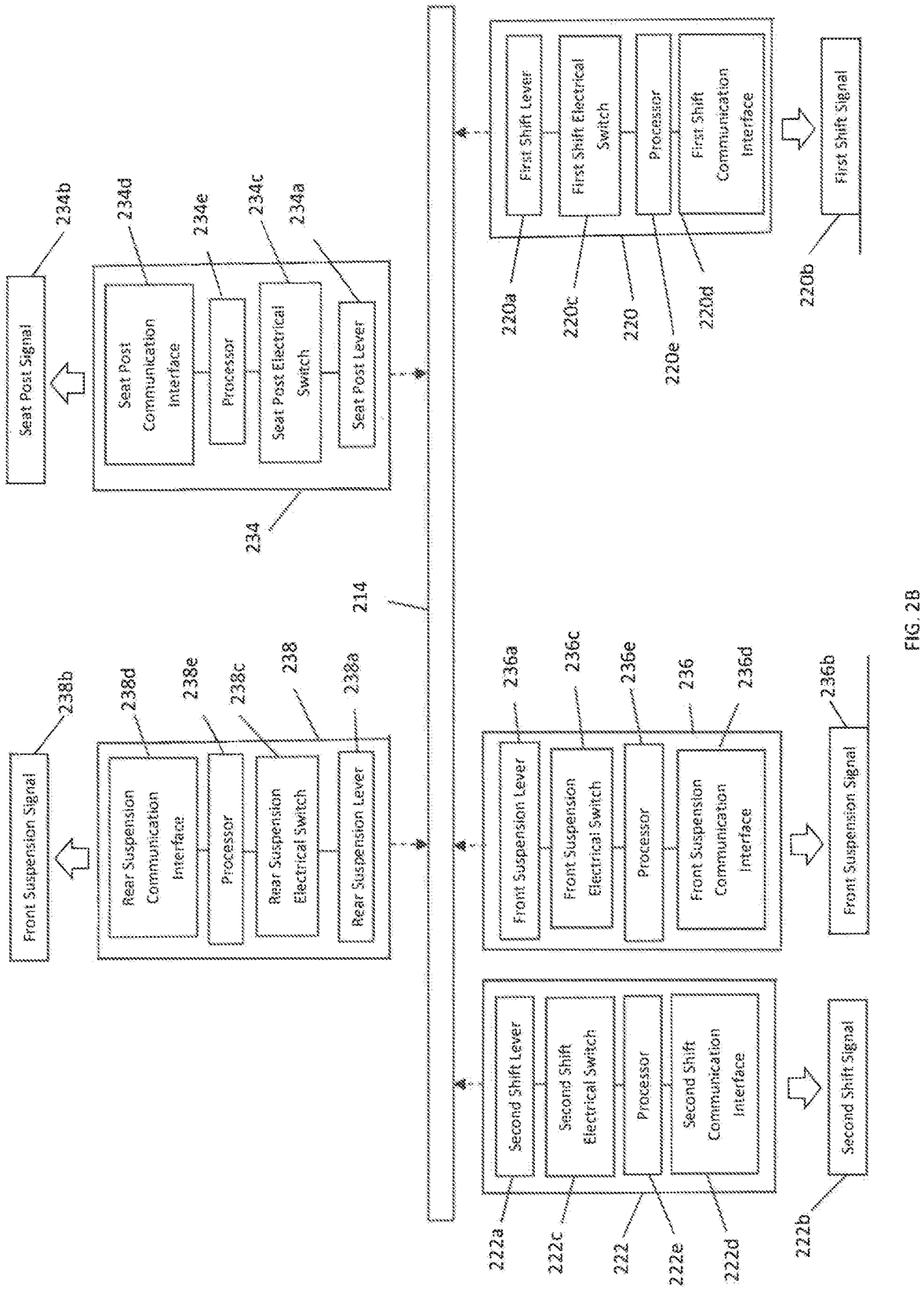
Seat Post Signal
234b
Seat Post Communication Interface
234d
Processor
234e
Seat Post Electrical Switch
234c
Seat Post Lever
234a
234
214
First Shift Lever
First Shift Electrical Switch
Processor
First Shift Communication Interface
First Shift Signal
220a
220c
220
220e
220d
220b
Front Suspension Signal
238b
Rear Suspension Communication Interface
238d
Processor
238e
Rear Suspension Electrical Switch
238c
Rear Suspension Lever
238
238a
Front Suspension Lever
236a
Front Suspension Electrical Switch
236c
Processor
236e
Front Suspension Communication Interface
236
236d
Front Suspension Signal
236b
Second Shift Lever
Second Shift Electrical Switch
Processor
Second Shift Communication Interface
Second Shift Signal
222a
222c
222
222e
222d
222b

FIG. 2B

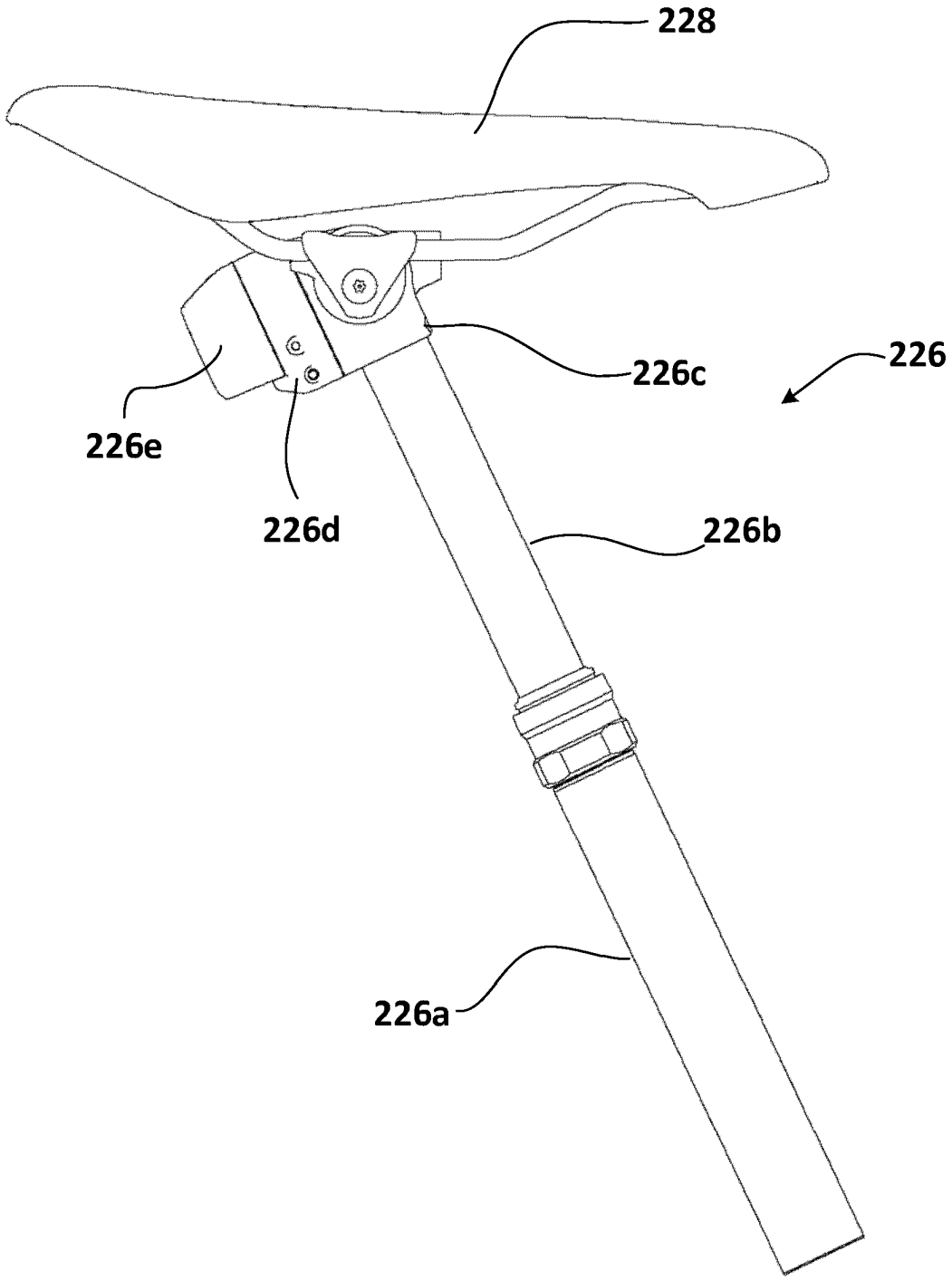

FIG. 2C

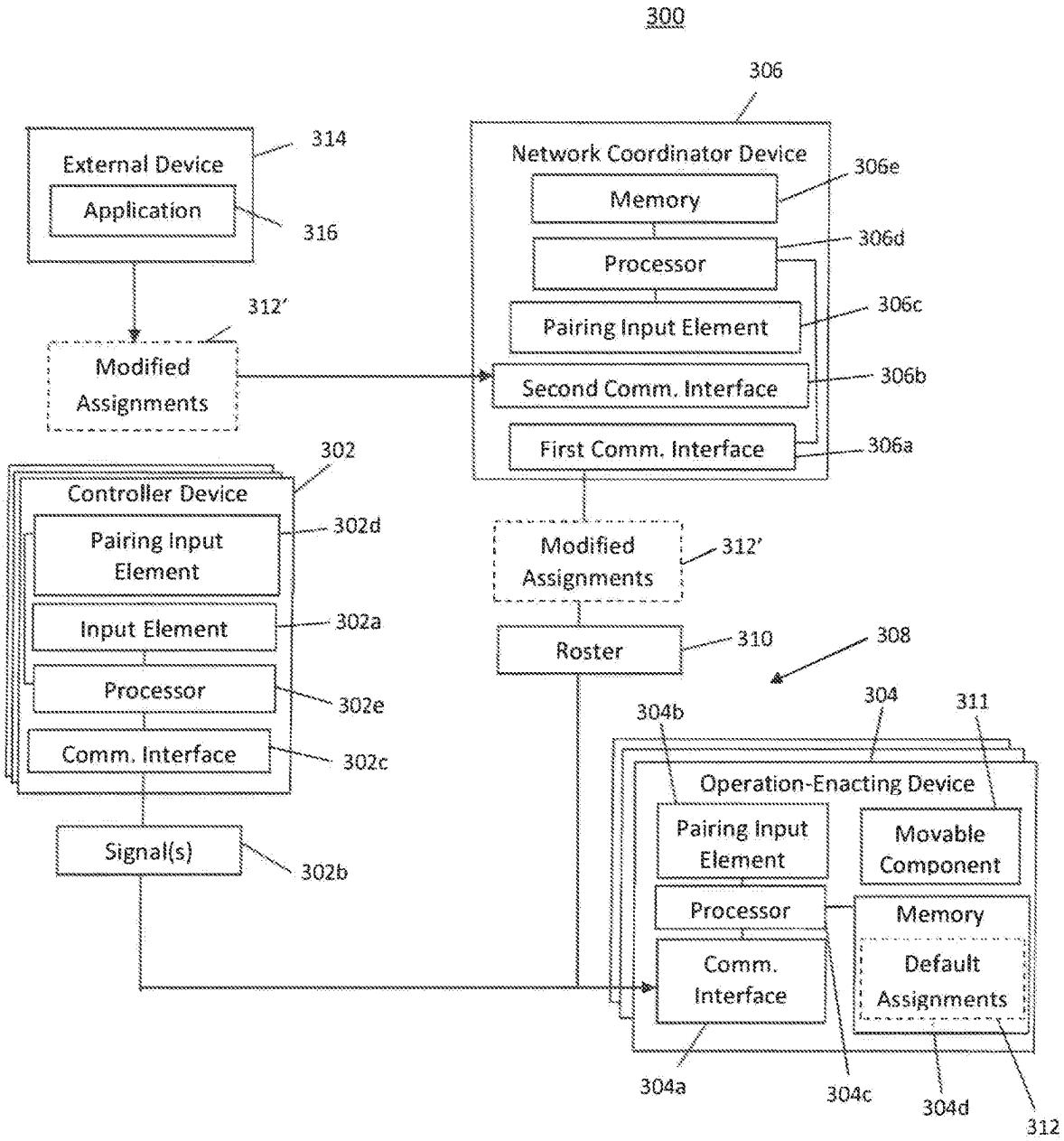
300
306
External Device
314
Application
316
312'
Modified Assignments
Network Coordinator Device
306e
Memory
306d
Processor
306c
Pairing Input Element
306b
Second Comm. Interface
306a
First Comm. Interface
302
Controller Device
302d
Pairing Input Element
302a
Input Element
302e
Processor
302c
Comm. Interface
Signal(s)
302b
Modified Assignments
312'
Roster
310
308
304
311
304b
Operation-Enacting Device
Pairing Input Element
Movable Component
Processor
Memory
Comm. Interface
Default Assignments
304a
304c
304d
312

FIG. 3

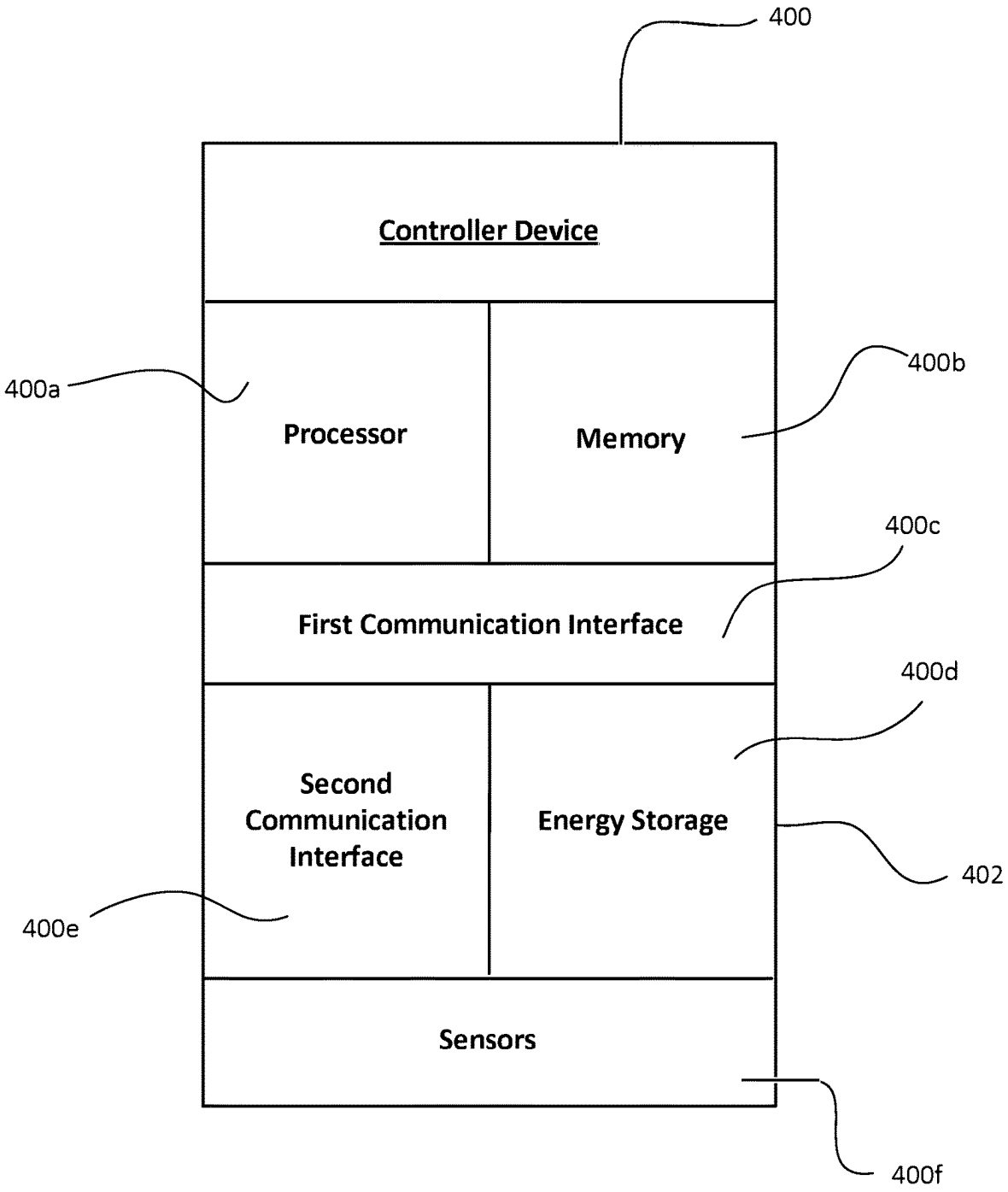
400
Controller Device
400a
Processor
Memory
400b
400c
First Communication Interface
400d
Second Communication Interface
Energy Storage
402
400e
Sensors
400f

FIG. 4

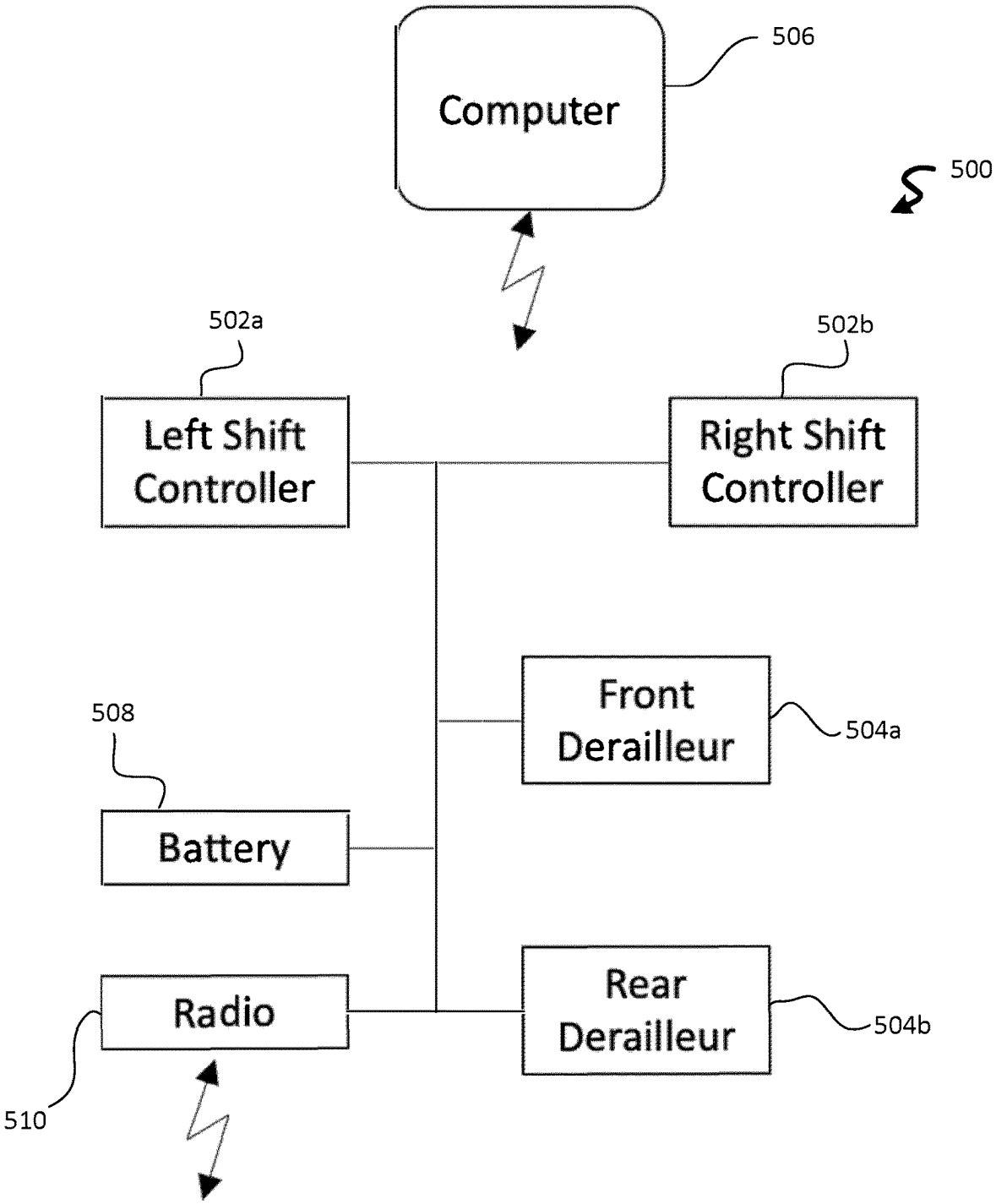
Computer
506
500
502a
502b
Left Shift Controller
Right Shift Controller
Front Derailleur
504a
508
Battery
Radio
Rear Derailleur
504b
510

FIG. 5

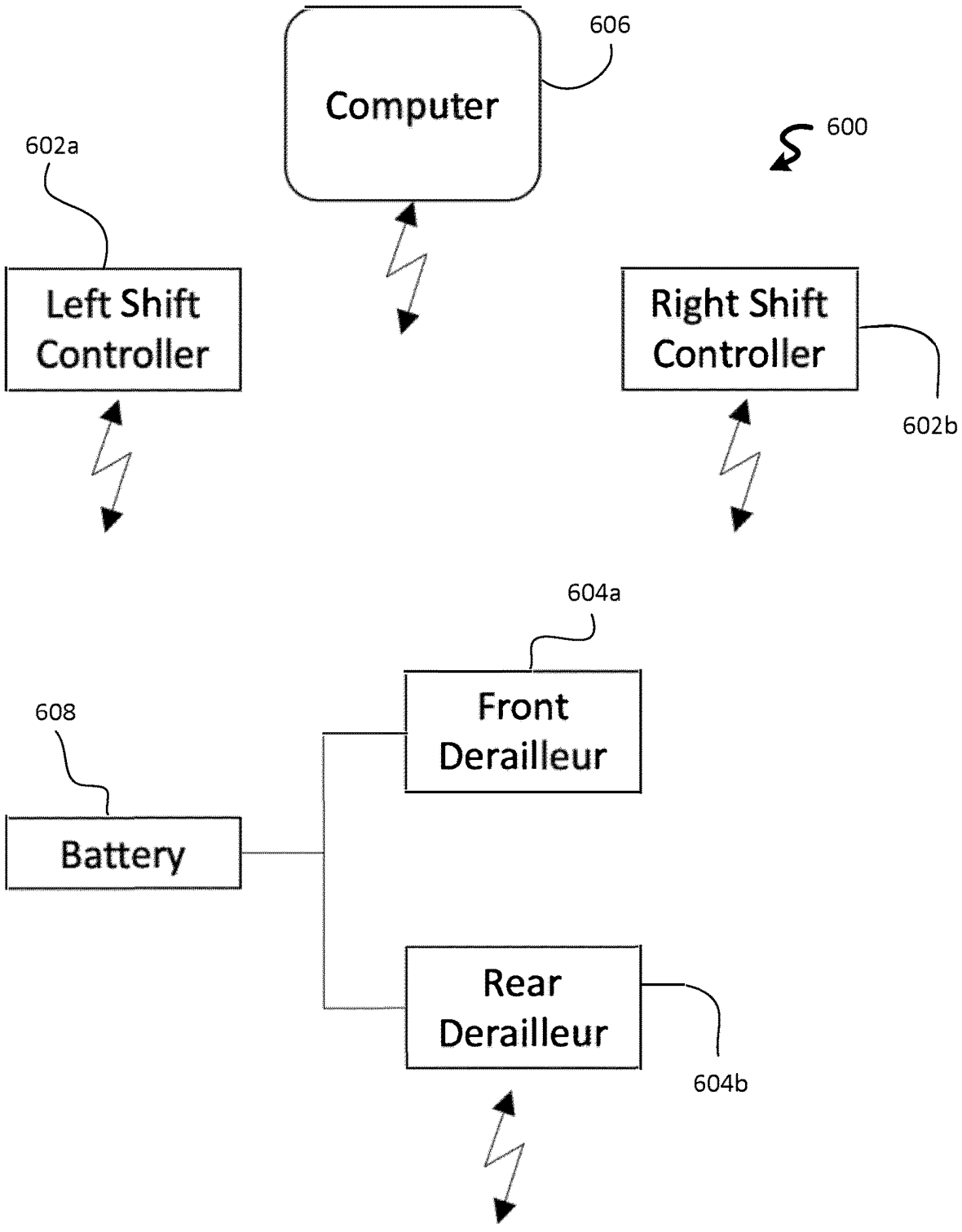
Computer
606
600
602a
Left Shift Controller
Right Shift Controller
602b
604a
Front Derailleur
608
Battery
Rear Derailleur
604b

FIG. 6

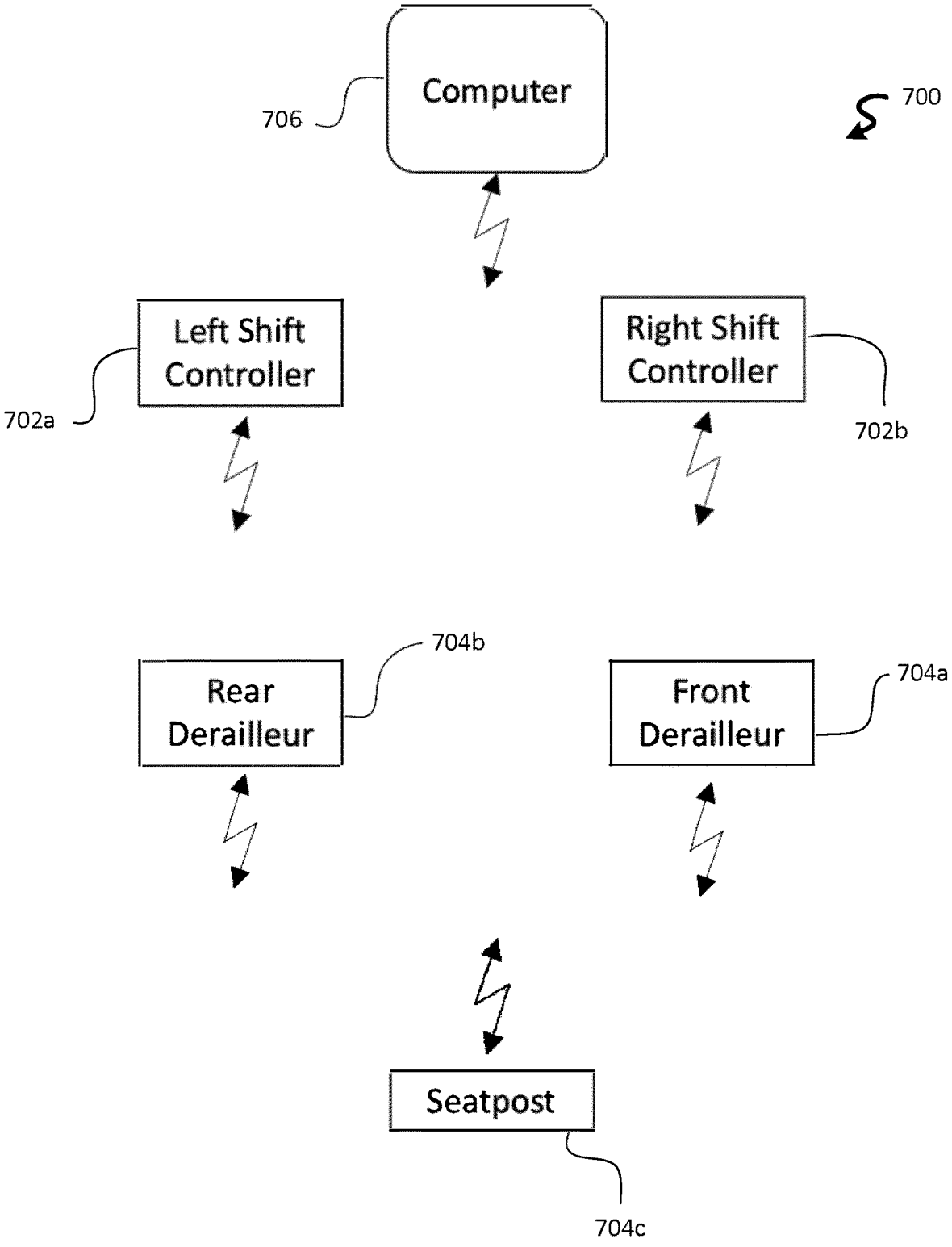
Computer
706
700
Left Shift Controller
702a
Right Shift Controller
702b
Rear Derailleur
704b
Front Derailleur
704a
Seatpost
704c

FIG. 7

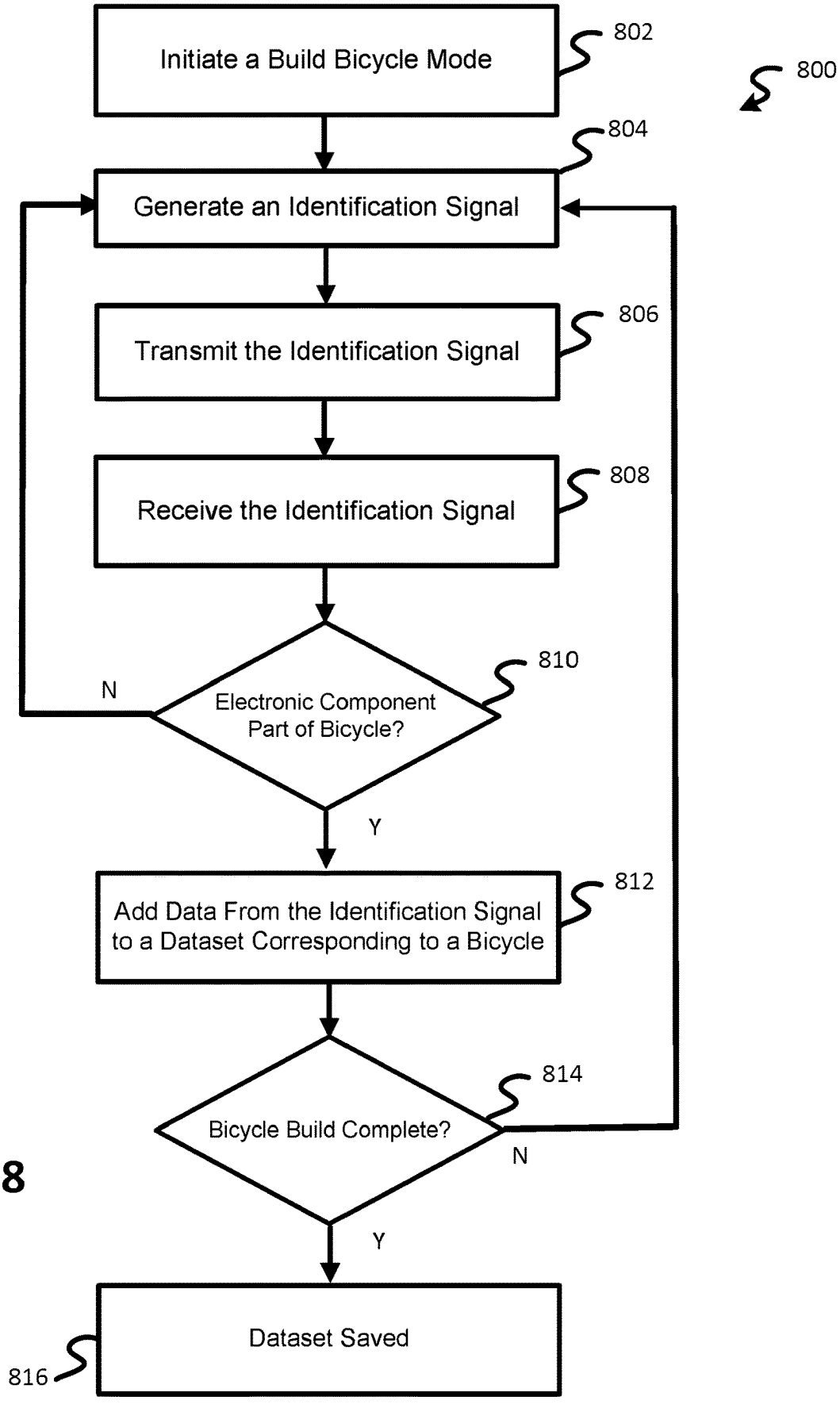
Initiate a Build Bicycle Mode
802
800
804
Generate an Identification Signal
806
Transmit the Identification Signal
808
Receive the Identification Signal
810
Electronic Component Part of Bicycle?
N
Y
812
Add Data From the Identification Signal to a Dataset Corresponding to a Bicycle
814
Bicycle Build Complete?
N
Y
Dataset Saved
816

FIG. 8

Bike ID	Friendly Bike Name	1st component ID	2nd component ID	3rd component ID	4th component ID	5th component ID
bike_1	TT road bike	front_derailleur_659	rear_derailleur_131	left_controller_557	right_controller_359	power_meter_701
bike_2	gravel bike	rear_derailleur_607	left_controller_419	right_controller_163	power_meter_727	
bike_3	mountain bike	rear_derailleur_937	right_controller_587	right_controller_360	seatpost_191	shock_811

FIG. 9

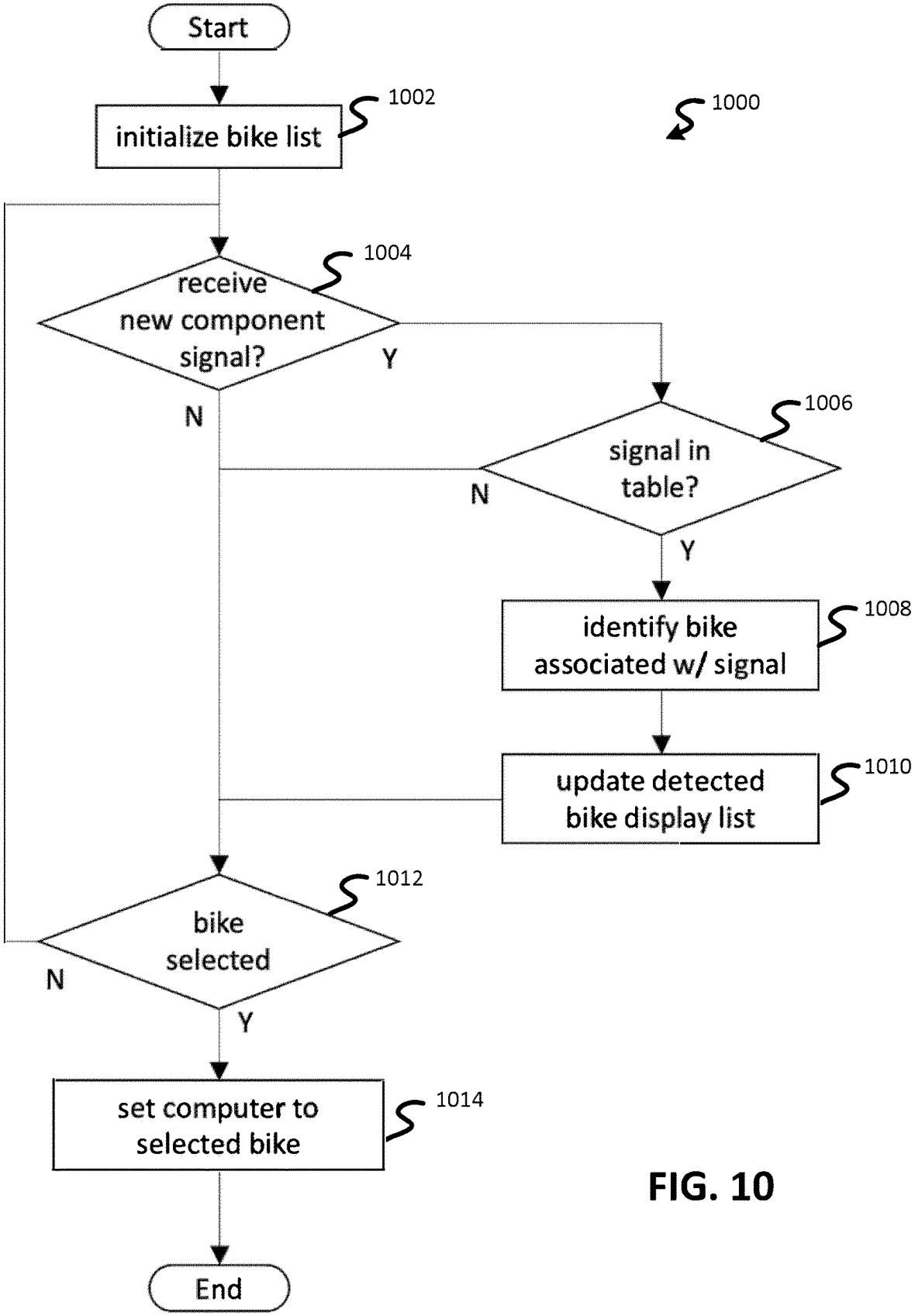
Start
initialize bike list
1002
1000
receive new component signal?
1004
Y
N
signal in table?
1006
N
Y
identify bike associated w/ signal
1008
update detected bike display list
1010
bike selected
1012
N
Y
set computer to selected bike
1014
End

FIG. 10

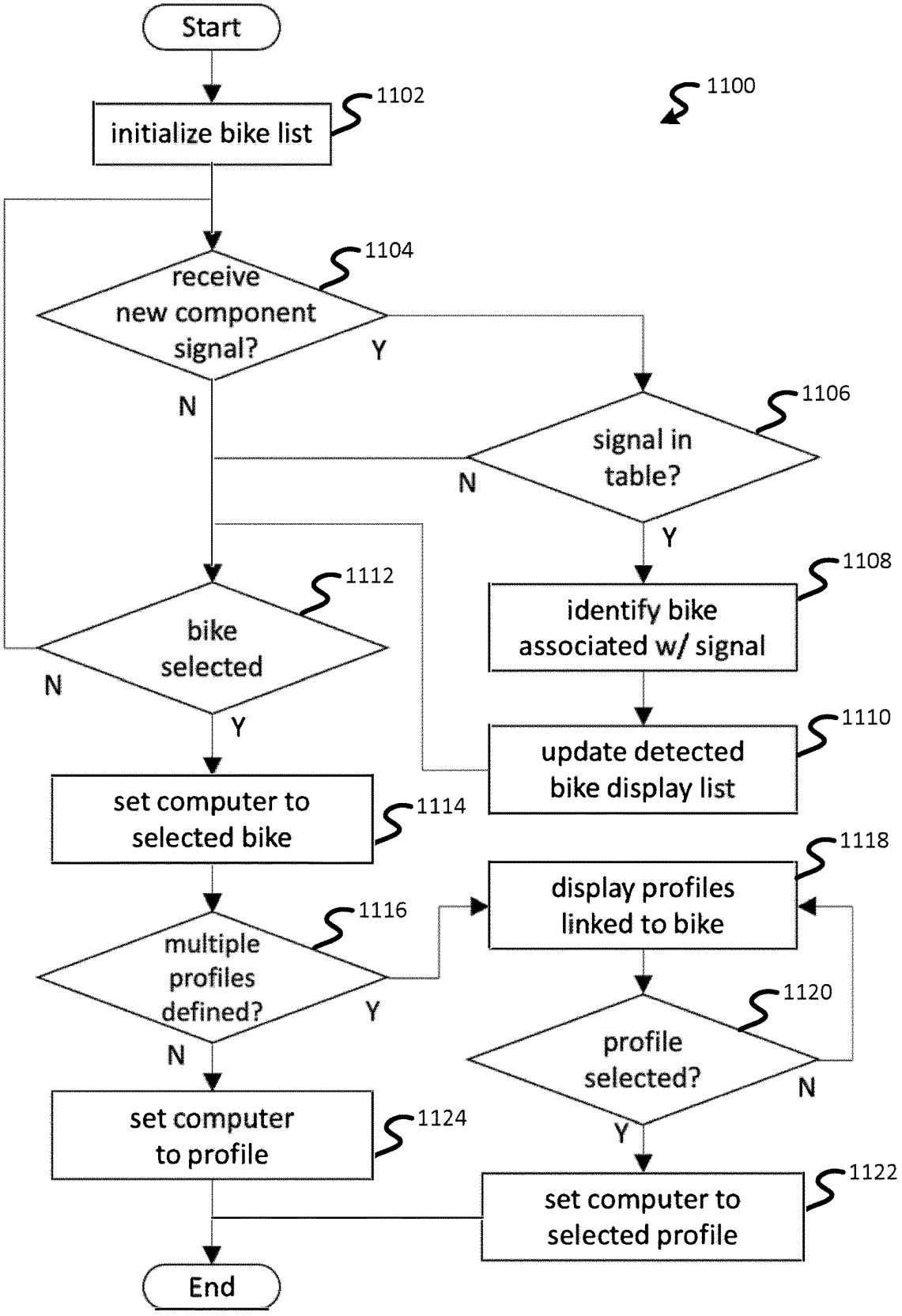
Start
initialize bike list
1102
1100
receive new component signal?
1104
Y
N
signal in table?
1106
N
Y
identify bike associated w/ signal
1108
update detected bike display list
1110
bike selected
1112
N
Y
set computer to selected bike
1114
display profiles linked to bike
1118
multiple profiles defined?
1116
Y
N
profile selected?
1120
N
Y
set computer to profile
1124
set computer to selected profile
1122
End

FIG. 11

Bike ID	Friendly Bike Name	1st profile	2nd profile	3rd profile	4th profile
bike_1	TT road bike	power + gear	power + heart rate	power + gear + heart rate	-
bike_2	gravel bike	power + gear	power + gear + hills	-	-
bike_3	mountain bike	gear + hills	-	-	-

FIG. 12

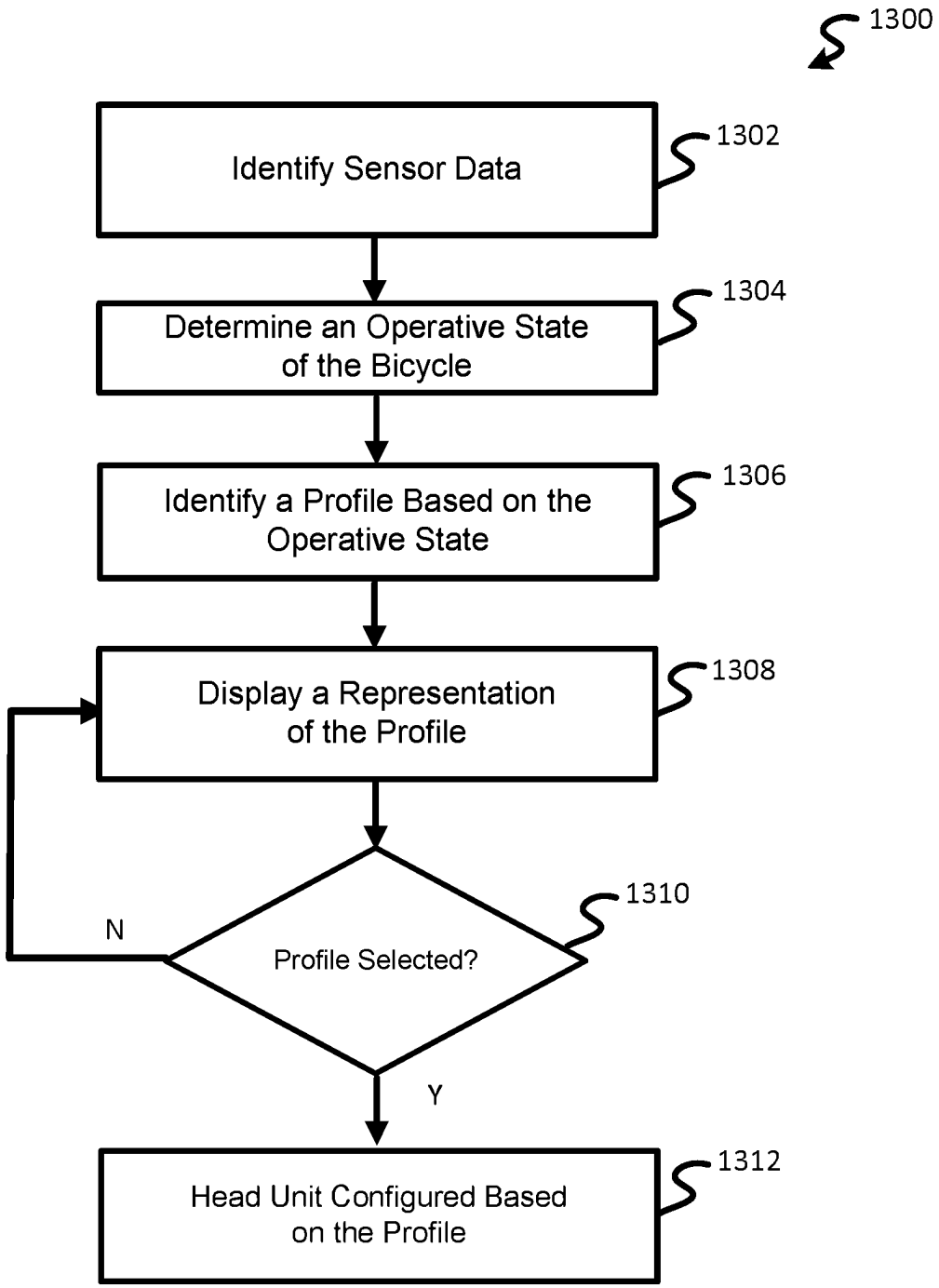
1300
Identify Sensor Data
1302
Determine an Operative State of the Bicycle
1304
Identify a Profile Based on the Operative State
1306
Display a Representation of the Profile
1308
Profile Selected?
1310
N
Y
Head Unit Configured Based on the Profile
1312

FIG. 13

AUTOMATIC BICYCLE SYSTEM AND USER PROFILE IDENTIFICATION

BACKGROUND

1. Field of the Disclosure

The present disclosure is generally directed to bicycle system identification, and more particularly, to bicycle system identification by a bicycle head unit.

2. Description of Related Art

A user of a bicycle head unit may own multiple bicycles, and may want to use the bicycle head unit on each of the multiple bicycles. Each of the multiple bicycles may be used in different conditions, and a desired head unit configuration may be different for each of the multiple bicycles.

SUMMARY

In one example, a controller device usable with a bicycle includes a communication interface configured to receive component data from another controller device. The other controller device is of the bicycle. The communication interface is further configured to receive auxiliary data from outside the bicycle. The controller device also includes a processor in communication with the communication interface. The processor is configured to determine a location of the bicycle based on the auxiliary data, compare the received component data to a plurality of predetermined component datasets for a plurality of bicycles, respectively, and identify at least one bicycle of the plurality of bicycles based on the comparison and the determined location of the bicycle. The at least one bicycle includes the bicycle. The controller device also includes a display in communication with the processor. The display is configured to display a representation for each bicycle of the at least one identified bicycle.

In one example, the controller device is a head unit that is usable with the at least one identified bicycle.

In one example, the communication interface includes a first communication interface configured to receive the component data from the other controller device, and a second communication interface configured to receive the auxiliary data from outside the bicycle. The first communication interface and the second communication interface are different types of communication interfaces, are configured to communicate using different techniques, protocols, or standards, or a combination thereof.

In one example, the second communication interface is configured to communicate with a WiFi network or a global positioning system (GPS). The auxiliary data includes data related to a WiFi device via which the second communication interface is connected to the WiFi network, GPS data, or a combination thereof.

In one example, the controller device also includes a memory configured to store the plurality of predetermined component datasets for the plurality of bicycles.

In one example, the received component data includes identification data for the other controller device. Each predetermined component dataset of the plurality of predetermined component datasets includes identification data for at least one component of the respective bicycle. The processor is further configured to determine whether, based on the comparison, the received identification data for the other controller device matches the identification data of the at least one bicycle of the plurality of bicycles. The identification includes identification of the at least one bicycle of the plurality of bicycles based on the determination of whether the received identification data for the other controller device matches the identification data of the at least one bicycle of the plurality of bicycles.

In one example, the memory is further configured to store predetermined location data for the plurality of bicycles, respectively. The processor is further configured to compare the determined location to the predetermined location data for the plurality of bicycles, respectively. The identification further includes identification of the at least one bicycle of the plurality of bicycles based on the comparison of the determined location to the predetermined location data for the plurality of bicycles, respectively.

In one example, the controller device also includes an input device. The processor is further configured to receive a user input selecting the representation of the bicycle via the input device. The processor is further configured to initiate display of one or more predetermined types of data by the display based on the received user input, initiate configuration of one or more components of the bicycle based on the received user input, or a combination thereof.

In one example, a controller device for a bicycle includes a communication interface configured to receive component data from another controller device of the bicycle. The controller device also includes a processor in communication with the communication interface. The processor is configured to identify the bicycle based on the received component data and identify sensor data from a sensor. The processor is further configured to determine an operative state of the bicycle based on the identified sensor data, and identify a user profile from a plurality of user profiles based on the determined operative state of the bicycle. The controller device also includes a display in communication with the processor. The display is configured to display one or more predetermined types of data based on the identified user profile, the processor is further configured to initiate configuration of one or more components of the bicycle based on the identified user profile, or a combination thereof.

In one example, the controller device also includes a memory configured to store the plurality of user profiles. Each user profile of the plurality of user profiles identifies at least one predetermined type of data to be displayed, a configuration for at least one component of the bicycle, or a combination thereof.

In one example, each user profile of the plurality of user profiles also includes one or more predetermined operative states. The identification of the user profile from the plurality of user profiles includes comparison of the identified sensor data to the respective one or more predetermined operative states for the user profile, and identification of the user profile from the plurality of user profiles based on the comparison.

In one example, the user profile is a profile specific to a particular rider of the bicycle, a profile specific to a riding scenario of the bicycle, or a profile specific to the particular rider and the riding scenario of the bicycle.

In one example, the sensor is a power meter of the bicycle, the identified sensor data includes output power data, and the respective one or more predetermined operative states for the user profile include a predetermined threshold output power. The comparison of the identified sensor data to the respective one or more predetermined operative states for the user profile includes comparison of the output power data to the predetermined threshold output power. The identification of the user profile from the plurality of user profiles based on the comparison includes identification of

the user profile from the plurality of user profiles when, based on the comparison, an output power of the output power data is greater than the predetermined threshold output power.

In one example, the sensor is a sensor of a seatpost system, the identified sensor data includes pressure data within the seatpost system, and the respective one or more predetermined operative states for the user profile includes a predetermined threshold pressure. The comparison of the identified sensor data to the respective one or more predetermined operative states for the user profile includes comparison of a pressure of the pressure data within the seatpost system to the predetermined threshold pressure. The identification of the user profile from the plurality of user profiles based on the comparison includes identification of the user profile from the plurality of user profiles when, based on the comparison, the pressure within the seatpost system is greater than the predetermined threshold pressure.

In one example, the controller device also includes the sensor. The sensor includes an accelerometer. The identified sensor data includes acceleration data from the accelerometer, and the respective one or more predetermined operative states for the user profile includes a predetermined threshold speed. The processor is further configured to determine a speed of the bicycle based on the acceleration data from the accelerometer. The comparison of the identified sensor data to the respective one or more predetermined operative states for the user profile includes comparison of the determined speed of the bicycle to the predetermined threshold speed. The identification of the user profile from the plurality of user profiles based on the comparison includes identification of the user profile from the plurality of user profiles when, based on the comparison, the determined speed of the bicycle is greater than the predetermined threshold speed.

In one example, the controller device is a head unit for the bicycle.

In one example, the one or more predetermined types of data include power data, heart rate data for a user of the bicycle, a gearing of the bicycle, or any combination thereof.

In one example, the identified user profile is a riding profile. The processor is further configured to identify two or more user profiles of the plurality of user profiles based on the identified bicycle. The two or more user profiles are rider profiles. The display is further configured to display two or more respective representations of the two or more rider profiles. The processor is further configured to receive a user input selecting a representation of the displayed two or more respective representations. The selected representation corresponds to a rider profile of the two or more rider profiles. The display is configured to display at least one predetermined type of data based on the selected rider profile, the processor is further configured to initiate configuration of at least one component of the bicycle based on the selected rider profile, or a combination thereof.

In one example, the riding profile is identified after the rider profile is selected.

In one example, a computer-implemented method for identifying a user profile from a plurality of user profiles associated with a bicycle includes receiving, by a processor of a head unit of the bicycle, component data from a controller device of the bicycle. The computer-implemented method also includes identifying, by the processor, the bicycle based on the received component data, identifying, by the processor, at least one user profile of a plurality of user profiles based on the identified bicycle, and displaying, by a display in communication with the processor, at least one representation corresponding to the at least one user profile, respectively. The computer-implemented method also includes receiving, by the processor, a user input. The user input identifies a representation of the displayed at least one representation. The identified representation corresponds to a first user profile of the plurality of user profiles. The computer-implemented method also includes displaying, by the display, at least one predetermined type of data based on the identified first user profile, initiating configuration of at least one component of the bicycle based on the identified first user profile, or a combination thereof. The computer-implemented method also includes receiving, by the processor, sensor data from a sensor of the bicycle, determining, by the processor, an operative state of the bicycle based on the identified sensor data, and identifying, by the processor, a second user profile from the plurality of user profiles based on the determined operative state of the bicycle. The computer-implemented method also includes displaying one or more predetermined types of data based on the identified second user profile, initiating configuration of one or more components of the bicycle based on the identified second user profile, or a combination thereof.

BRIEF DESCRIPTION OF THE DRAWINGS

Objects, features, and advantages of the present invention will become apparent upon reading the following description in conjunction with the drawing figures, in which:

FIG. **1**A is a right-side view of an example road bicycle that may implement aspects of the present disclosure;

FIG. **1**B is a schematic diagram of a handlebar assembly of the example road bicycle shown in FIG. **1**A, and other components coupled to the handlebar assembly;

FIG. **1**C is a side view of a front derailleur of an example road bicycle;

FIG. **1**D is a side view of a rear derailleur of the example road bicycle shown in FIG. **1**;

FIG. **1**E is a side view of a right controller device of the example road bicycle shown in FIG. **1**A coupled to a right drop bar;

FIG. **2**A is a right-side view of an example mountain bicycle that may implement aspects of the present disclosure;

FIG. **2**B is a schematic diagram of a handlebar assembly of the example mountain bicycle shown in FIG. **2**A, and other components coupled to the handlebar assembly;

FIG. **2**C is a side view of a seat post assembly, with a saddle installed thereon, of the example mountain bicycle shown in FIG. **2**A;

FIG. **3** illustrates an example system for controlling different combinations of operation-enacting devices on a bicycle, according to aspects of the present disclosure;

FIG. **4** illustrates an example controller device, according to aspects of the present disclosure;

FIG. **5** illustrates an example system for controlling a first combination of operation-enacting devices on a bicycle, according to aspects of the present disclosure;

FIG. **6** illustrates an example system for controlling a second combination of operation-enacting devices on a bicycle, according to aspects of the present disclosure;

FIG. **7** illustrates an example system for controlling a third combination of operation-enacting devices on a bicycle, according to aspects of the present disclosure;

FIG. **8** is a flow chart of an embodiment of a method for generating component datasets representing different bicycle systems, respectively;

FIG. **9** is an example of a chart of component datasets representing different bicycle systems, respectively;

FIG. **10** is a flow chart of an embodiment of a method for detecting a unique bicycle system;

FIG. **11** is a flow chart of an embodiment of a method for detecting a unique bicycle system and identifying a user profile for the unique bicycle system;

FIG. **12** is an example of a chart of user profiles corresponding to the different bicycle systems of FIG. **9**; and

FIG. **13** is a flow chart of an embodiment of a method identifying another user profile for the unique bicycle system.

Other aspects and advantages of the embodiments disclosed herein will become apparent upon consideration of the following detailed description, wherein similar or identical structures have similar reference numerals.

DETAILED DESCRIPTION OF THE DISCLOSURE

Multiple bicycles owned and/or used by a user of a bicycle head unit, for example, may include different bicycle components (e.g., devices) and/or different sensors, respectively. When the bicycle head unit is paired into a network of one of the different bicycles (e.g., a unique bicycle), bicycle components of the unique bicycle transmit component data to the head unit via the network. The component data includes identification data (e.g., a component identification number) for at least one of the bicycle components of the unique bicycle.

The head unit compares the component data to a plurality of predetermined component datasets that represent a plurality of bicycles (e.g., a plurality of predetermined bicycle configurations that represent the plurality of bicycles), respectively. The head unit may identify the unique bicycle from the plurality of bicycles based on the comparison.

The identification of the unique bicycle from the plurality of bicycles may also be based on auxiliary data received from a source off the bicycle. For example, the auxiliary data may include location data of the unique bicycle received from a WiFi network or a global positioning system (GPS) outside of the unique bicycle. Each predetermined bicycle configuration of the plurality of predetermined bicycle configurations may include predetermined location data (e.g., for a location the respective bicycle is stored, such as a garage at a home). The head unit may compare the received location data to the predetermined location data of the plurality of predetermined bicycle configurations, and the head unit may identify the unique bicycle from the plurality of bicycles also based on this comparison.

The head unit may identify a plurality of user profiles associated with the identified unique bicycle. Each user profile of the plurality of user profiles may identify types of data to be displayed at the head unit and/or at another computing device of the bicycle, and/or settings for the bicycle components of the unique bicycle (e.g., a gear setting for a rear derailleur and/or a seat post height setting for a seat post assembly of the unique bicycle; what data to be tracked by what sensors of the unique bicycle), for example. Representations of the plurality of user profiles may be presented (e.g., displayed) to a user at the head unit and/or another computing device of the unique bicycle, and the user may select a user profile of the plurality of user profiles by selecting one of the representations. Alternatively, the head unit may identify an operative state (e.g., a speed of the unique bicycle, an acceleration of the unique bicycle, a pressure on a seat of the seat post assembly) of the unique bicycle based on, for example, sensor data from one or more sensors of the unique bicycle, and select a user profile of the plurality of user profiles based on the identified operative state of the unique bicycle.

The present embodiments provide a mechanism that allows a single head unit to automatically recognize multiple unique bicycles (e.g., auto-recognition). The auto-recognition of a unique bicycle by the head unit allows the head unit to automatically load a head unit configuration associated with the unique bicycle. Head unit auto-recognition of the unique bicycle may save time during pre-ride setup, eliminating the need to reactivate sensors and reconfigure head unit preferences for the unique bicycle. Further, once the head unit recognizes the unique bicycle, data being collected by the head unit and/or the sensors of the unique bicycle for a particular ride may be associated with the unique bicycle, such that analytics for the unique bicycle such as, for example, service interval recommendations, total ride time, and/or total elevation gain or loss may be provided.

Wireless communication between components is described herein. Although the present specification describes components and functions that may be implemented in particular wireless communication embodiments with reference to particular standards and protocols, the invention is not limited to such standards and protocols. For example, standards for Internet and other packet switched network transmission (e.g., TCP/IP, UDP/IP, HTML, HTTP, HTTPS) represent examples of the state of the art. Such standards are periodically superseded by faster or more efficient equivalents having essentially the same functions. Accordingly, replacement standards and protocols having the same or similar functions as those disclosed herein are considered equivalents thereof.

In an embodiment, components of the bicycle described herein will communicate with each other. In the case of wireless communication, the components will initially be paired so as to allow secure communication between components on the bicycle without interference from devices not associated with the system. One or more of the components may also be paired with a separate device such as a computer (e.g., a removable head unit), tablet, or phone (e.g., a mobile computing device). This paired device may provide the user interface to allow the user to communicate with the components on the bicycle. Examples of communication are updating firmware, setting variables, and running diagnostic tools and analysis.

FIG. **1**A illustrates a right side view of an example road bicycle **100**. The bicycle **100** includes a frame **102**, a front wheel **104**, a rear wheel **106**, and a drivetrain **108**. The front wheel **104** and the rear wheel **106** are rotatably coupled to the frame **102**. The bicycle **100** includes a front brake **110** for braking the front wheel **104** and a rear brake **112** for braking the rear wheel **106**. To allow a user to steer the bicycle **100**, the bicycle **100** includes a handlebar assembly **114** attached to the frame **102**.

FIG. **1**B illustrates a schematic diagram depicting the handlebar assembly **114** and other components coupled to the handlebar assembly **114**. As shown in FIG. **1**A and/or FIG. **1**B, the handlebar assembly **114** includes a right drop bar **114***a* and a left drop bar **114***b* to accommodate the right hand and the left hand of the user, respectively. The bicycle **100** includes a first or right controller device **120** coupled to the right drop bar **114***a*. The first controller device **120** includes a first or right brake lever **116** to allow the user to operate the rear brake **112**. Correspondingly, the bicycle **100** includes a second or left controller device **122** coupled to the left drop bar **114***b*. The second controller device **122** includes a second or left brake lever **118** to allow the user to operate the front brake **110**.

As shown in FIGS. **1**A, **1**C, and **1**D, the drivetrain **108** includes a drive chain **108***a*, a front crank **108***b*, one or more front chainrings **108***c*, a front gear changer such as an electromechanical front derailleur **108***d*, rear sprockets **108***e*, and a rear gear changer such as an electromechanical rear derailleur **108***f*. The front chainrings **108***c* are coupled to the front crank **108***b*. Diameters and numbers of teeth on the front sprockets **108***c* may differ from each other. The rear sprockets **108***e* are coaxially mounted to the rear wheel **106**. Diameters and numbers of teeth on the rear sprockets **108***e* may decrease from left to right. Alternatively, the diameters and the numbers of teeth on the rear sprockets **108***e* may decrease from right to left. The chain **108***a* engages a selected chainring **108***c* and a selected sprocket **108***e*.

To drive the bicycle **100**, the user may pedal to rotate the front crank **108***b* relative to the frame **102**. Rotation of the front crank **108***b* causes the selected chainring **108***c* to rotate and the chain **108***a* to move through the drivetrain **108**. Movement of the chain **108***a* causes corresponding rotation of the selected sprocket **108***e* and thus the rear wheel **106**. Rotation of the rear wheel **106** against the ground may propel the bicycle **100** in a forward direction. The front and/or forward orientation and movement of the bicycle **100** is indicated by the direction of arrow "A." Further, other terms relating to direction may be used herein. For example, the "inboard" and "outboard," and "left" and "right" may be used. The terms "right" and "left," and "inboard" and "outboard" describe a position between parts or items and a vertical plane substantially bisecting the bicycle or a direction toward or away from the vertical plane substantially bisecting the bicycle. Moreover, terms such as "front" and "rear" referred to bicycle mechanisms conventionally mounted to the bicycle and with the bicycle oriented in the forward direction.

The selected chainring **108***c* and the selected sprocket **108***e*, in combination, determine a gear ratio for driving the bicycle **100**. Operation of the front derailleur **108***d* allows the user to change the selected chainring **108***c* engaged by the chain **108***a*. For example, the front derailleur **108***d* may be actuated to shift the chain **108***a* left or right from one chainring **108***c* to the other. The front derailleur **108***d* is shown as a wireless electrically-actuated front derailleur mounted to the frame **102**. The front derailleur **108***d* may include a base member **108***g* mounted to the bicycle frame **102** and a chain guide assembly **108***h* or cage movably connected to the base member **108***g* by a front linkage **108***i* in the form of a parallelogram. A front power supply **108***j* (e.g., a removable battery) may be mounted on the front derailleur **108***d*. The front power supply **108***j* may supply power to a front motor unit **108***k*. The front motor unit **108***k* is configured to supply torque to the components of the front derailleur **108***d* to move the chain guide assembly **108***h* relative to the front base member **108***g* such that the front derailleur **108***d* may shift the chain **108***a* between the front sprockets **108***c*.

Operation of the rear derailleur **108***f* allows the user to change the selected sprocket **108***e* engaged by the chain **108***a*. For example, the rear derailleur **108***f* may be actuated to shift the chain **108***a* left or right from one sprocket **108***e* to another. The rear derailleur **108***f* is shown in FIGS. **1**A and **1**D as a wireless electrically-actuated rear derailleur mounted to the frame **102**. The rear derailleur **108***f* may include a base member **108***l* (e.g., a b-knuckle) that is mounted to the bicycle frame **102**. A linkage **108***m* may include two links **108***n* that are pivotally connected to the base member **108***l*. A movable member **1080** (e.g., a p-knuckle) may be connected to the linkage **108***m*. A chain guide assembly **108***q* or cage may be configured to engage and maintain tension in the chain **108***a* and may be pivotally connected to a part of the movable member **1080**.

A motor unit **108***r* and rear power supply **108***s* (e.g., a removable battery) are disposed on the rear derailleur **108***f*. The battery **108***s* supplies power to the motor unit **108***r*. In this embodiment, the motor unit **108***r* is disposed in the movable member **1080**. Alternatively, the motor unit **108***r* may be disposed in one of the links **108***n* or in the base member **108***l*. The motor unit **108***r* may include a motor and a gear transmission. The motor unit **108***r* may be coupled with the linkage **108***m* to laterally move the cage **108***q* and thus shift the chain **108***a* among the rear sprockets **108***e*.

Referring to FIGS. **1**A, **1**B, and **1**E, to allow the user to operate the front derailleur **108***d* or the rear derailleur **108***f*, the first controller device **120** and the second controller device **122** include a first electrical switch **120***c* and a second electrical switch **122***c*, respectively. The first electrical switch **120***c* and the second electrical switch **122***c* are actuated by a first input element and a second input element, respectively (e.g., the first shift lever **120***a* and the second shift lever **122***a*, respectively; actuators). The first shift lever **120***a* is configured to receive a right input from the right hand of the user and actuate the first electrical switch **120***c*. The second shift lever **122***a* is configured to receive a left input from the left hand of the user and actuate the second electrical switch **122***c*. The first shift lever **120***a* may be positioned behind the first brake lever **116**, while the second shift lever **122***a* may be positioned behind the second brake lever **118**.

To provide the right input to the first shift lever **120***a*, the user may manually apply pressure on the right side of the first shift lever **120***a*. In response, the first shift lever **120***a* may pivot about a first shift lever axis L**1** from an initial rest position to a shift actuation position. The first shift lever **120***a* may be biased with a spring or the like so that when the manual pressure is no longer applied by the user, the first shift lever **120***a* returns to the initial rest position. Similarly, to provide the left input to the second shift lever **122***a*, the user may manually apply pressure on the left side of the second shift lever **122***a*. In response, the second shift lever **122***a* may pivot about a second shift lever axis (not shown) from an initial rest position to a shift actuation position. The second shift lever **122***a* may be biased with a spring or the like so that when the manual pressure is no longer applied by the user, the second shift lever **122***a* returns to the left starting position.

The first controller device **120** and the second controller device **122** include a first controller processor **120***e* and a second controller processor **122***e*, respectively, that electronically process the manual input received by the first shift lever **120***a* and the second shift lever **122***a*, respectively. For example, the right input triggers a first controller communication interface **120***d* to wirelessly send a first shift signal **120***b*, and the left input triggers a second controller communication interface **122***d* to wirelessly send a second shift signal **122***b*. Correspondingly, the front derailleur **108***d* and the rear derailleur **108***f* include communication interfaces and processors that are configured to receive and electronically process the first shift signal **120***b* and/or the second shift signal **122***b* to determine a designated response.

As shown in FIGS. **1**A and **1**B, the first controller device **120** and the second controller device **122** employ the first shift lever **120***a* and the second shift lever **122***a* as respective input elements to generate corresponding wireless shift signals **120***b*, **122***b* (e.g., including messages and/or message packets) to actuate the front derailleur **108***d* and the rear

derailleur **108***f*. Alternative embodiments, however, may include controller devices with different configurations to control a front derailleur and/or a rear derailleur. For example, a bicycle may include aerobars with pushbuttons instead of drop bars with shift levers, where the pushbuttons act as input elements that may be pressed by the user to generate wireless signals that may be received and processed by the front derailleur and the rear derailleur. Also, while some controller devices may be coupled to handlebar assemblies, other controller devices may be coupled to other areas of a bicycle, such as locations throughout the frame. Further, other types of controller devices are contemplated. For example, a unified shifter device may be employed, where the user may press one or more pushbuttons on a mounted box to send signals that control the front derailleur and/or the rear derailleur. Alternatively, a pedal sensor may be employed to receive input from the user via pedaling action by the user, and the front derailleur and/or the rear derailleur may respond to a signal from the pedal sensor (e.g., select gears to maintain a desired cadence or pedal resistance).

As shown in FIG. **1**A, the bicycle **100** also has a user interface **130** that is handlebar mounted. The user interface **130** may be a human-machine interface (HMI) and may include one or more buttons (e.g., for pairing), sensors, a display, a sound generator, one or more processors, memory, one or more communication interfaces (e.g., a first wireless communication interface and a second wireless communication interface), and/or other components. The user interface **130** may include more, fewer, and/or different components. In one embodiment, the user interface **130** is a head unit. For example, the user interface **130** is a removable head unit that may be installed on a plurality of bicycle, including the bicycle **100**.

While the example bicycle **100** shown in FIGS. **1**A and **1**B is a road bicycle, aspects of the present disclosure may be implemented with bicycles of any type. For example, FIG. **2**A illustrates a right side view of an example mountain bicycle **200**. In some cases, the bicycle **200** may be an e-bike. The bicycle **200** includes a frame **202**, a front wheel **204**, a rear wheel **206**, a drivetrain **208**, front disk brakes **210**, and rear disk brakes **212**. The drivetrain **208** includes a chain **208***a*, a front crank **208***b*, a front chainring **208***c*, rear sprockets **208***e*, and a rear derailleur **208***f*, which operate in a manner similar to the corresponding components of the drivetrain **108** described above.

In contrast to the bicycle **100**, the bicycle **200** includes other operating-enacting devices such as a height-adjustable seat post assembly **226**, a front suspension system **230** (e.g., a front suspension assembly), and a rear suspension system **232** (e.g., a rear suspension assembly). In FIGS. **2**A and **2**C, the seat post assembly **226** is a wireless, electrically-actuated seat post assembly **226** that allows a position of a seat **228** (e.g., a saddle) to be dynamically adjusted. For example, the adjustable seat post **226** may include an operable valve (not shown) that allows the seat **228** to be dropped to a lower height during a ride to change the position of the user (e.g., a rider) relative to the frame **202** and achieve better handling. The seat post assembly **226** includes a first or lower tube **226***a* and a second or upper tube **226***b* (e.g., two tubes). The two tubes **226***a*, **226***b* are movable relative to each other to establish a height of the seat **228** relative to the frame **202**. A head **226***c* is fixed to a top of the second tube **226***b*. A seat post motor unit **226***d* is mounted to the head **226***c*, and a power supply **226***e* (e.g., a removable battery) is attached to the motor unit **226***d*. The motor unit **226***d* may include a motor and a gear transmission. The seat post power supply **226***e* may supply power to the seat post motor unit **226***d*. The seat post motor unit **226***d* is configured to supply torque to the components of the seat post assembly **226** to open and close the operable valve.

The front suspension system is shown as a wireless, electrically-actuated front suspension system **230** that allows the suspension characteristics at the front wheel **204** to be dynamically adjusted. Further, the rear suspension system is shown as a wireless, electrically-actuated rear suspension system **232** that allows suspension characteristics at the rear wheel **206** to be dynamically adjusted. The front suspension system **230** and the rear suspension system **232** may further include power supplies such as batteries that supply power to a front suspension motor unit and a rear suspension motor unit, respectively. The front suspension motor unit and the rear suspension motor unit may be configured to supply torque to the components of the front suspension system **230** and the rear suspension system **232**, respectively, to open and close one or more valves to change various suspension characteristics.

Referring to FIGS. **2**A and **2**B, the bicycle **200** includes a first or right controller device **220** and a second or left controller device **222**. The first controller device **220** and the second controller device **222** include a first electrical switch **220***c* and a second electrical switch **222***c*, respectively, that are actuated by a first input element and a second input element, respectively (e.g., a first shift lever or button **220***a* and a second shift lever or button **222***a*, respectively; actuators). The handlebar assembly **214** includes a flat bar or a riser bar instead of drop bars. As such, the first controller device **220** is coupled to a right side of the flat or riser bar, and the second controller device **222** is coupled to a left side of the flat or riser bar. Additionally, the bicycle **200** may include a seat post controller device **234**, a front suspension controller device **236**, and a rear suspension controller device **238** coupled to the handlebar assembly **214**. In other embodiments, one or more of the controller devices (e.g., the first controller device **220** and the seat post controller device **234**) may be formed by a single controller device (e.g., a single lever or button).

The user may operate the first shift lever **220***a* and/or the second shift lever **222***a* as described above to generate a first shift signal **220***b* and/or a second shift signal **222***b*, respectively. Similar to the bicycle **100**, the first shift signal **220***b* and/or the second shift signal **222***b* may be employed to control the rear derailleur **208***f*. To allow the user to adjust the height of the seat post assembly **226**, the seat post controller device **234** includes a seat post electrical switch **234***c* that is actuated by a seat post input element **234***c* such as a lever or button.

To allow the user to adjust the characteristics of the front suspension system **230** and the rear suspension system **232**, the front suspension controller device **236** and the rear suspension controller device **238** include a front suspension electrical switch **236***c* and a rear suspension electrical switch **238***c* that are actuated by suspension input elements **236***a*, **238***a*, respectively, such as levers or buttons. Alternatively, the adjustable seat post assembly **226**, the adjustable front suspension system **230**, and the adjustable rear suspension system **232** may also be configured to receive the first shift signal **220***b* and/or the second shift signal **222***b*, so that these devices may also be controlled by operation of the first shift lever **220***a* and/or the second shift lever **222***a*.

The seat post controller device **234**, the front suspension controller device **236**, and the rear suspension controller device **238** include processors **234***e*, **236***e* **238***e*, respectively, that electronically process the manual input received by the seat post input element **234***a*, the front suspension

input element **236***a*, and the rear suspension input element **238***a*, respectively. The seat post input triggers a seat post controller communication interface **234***d* to wirelessly send a seat post signal **234***b*. The front and rear suspension inputs trigger front and rear controller communication interfaces **236***d*, **238***d*, respectively, to wirelessly send a front suspension signal **236***b* and a rear suspension signal **238***b*, respectively. Correspondingly, the seat post assembly **226** includes a communication interface and a processor that is configured to receive and electrically process the seat post signal **234***b* to determine a designated response. The front and rear suspensions include communication interfaces and processors that are configured to receive and electronically process the front suspension signal **236***b* and the rear suspension signal **238***b*, respectively, to determine a designated response.

As shown in FIG. **2**A, the bicycle **200** also has a user interface **240** that is handlebar mounted. The user interface **240** may be a human-machine interface (HMI) and may include one or more buttons (e.g., for pairing and/or selecting a user profile), sensors, a display, a sound generator, one or more processors, memory, one or more communication interfaces (e.g., a first wireless communication interface and a second wireless communication interface), and/or other components. The user interface **240** may include more, fewer, and/or different components. In one embodiment, the user interface **240** is a head unit. For example, the user interface **240** is a removable head unit that may be installed on a plurality of bicycle, including the bicycle **200**.

FIGS. **1**A-**1**E and **2**A-**2**C illustrate how various controller devices may be employed to wirelessly communicate control signals to different combinations of operation-enacting devices. The signals from the controller devices may be communicated wirelessly using any technique, protocol, or standard. For instance, Institute of Electrical and Electronics Engineers ("IEEE") 802.11 standards, IEEE 802.15.1 or BLUETOOTH® standards, and/or ANT™ or ANT+™ standards may be used. In some embodiments, however, control signals may be communicated wirelessly over a proprietary protocol, such as one that operates on top of the physical layer of the IEEE 802.15.4 wireless protocol.

FIG. **3** illustrates an example system **300** for controlling different combinations of operation-enacting devices on a bicycle. The system **300** includes a plurality of controller devices **302**. Each controller device **302** includes at least one respective input element **302***a* configured to receive input from a user. For example, as described above, the controller devices **302** may include a right controller device and a left controller device coupled to a handlebar assembly, where respective shifter levers act as input elements **302***a*. In general, input elements **302***a* may include any variety of shifter, pushbutton, clicker, switch, other toggled device, sensor (e.g., peddling sensor, etc.), or the like. A single controller device **302** may also include more than one input element **302***a* (e.g., two shifter levers, a plurality of pushbuttons, etc.). In one embodiment, at least some controller devices of the plurality of controller devices **302** do not include an input element.

Each controller device of the plurality of controller devices **302** may include one or more additional components. For example, a respective controller device **302** may include a processor **302***e*, a communications interface **302***c*, and/or a memory. The plurality of controller devices **302** are configured to transmit to, for example, a plurality of operation-enacting devices **304**, signals **302***b* (e.g., data streams including messages and/or message packets) indicating input received by the input elements **302***a* of the controller devices **302**. For example, the first controller device **120** and the second controller device **122** may wirelessly transmit a first shift signal **120***b* and a second shift signal **120***a* as described above to indicate input received by the first shift lever **120***a* and the second shift lever **122***a*, respectively. The communications interface **302***c* may be or include any number of different types of transmitters. For example, the communications interface **302***c* may be or include a combined transmitter and receiver.

The system **300** also includes the plurality of operation-enacting devices **304**, where each operation-enacting device **304** is configured to enact at least one respective operation on the bicycle. For example, the operation-enacting devices **304** may include a front derailleur, a rear derailleur, a height-adjustable seat post assembly, a front suspension system, and/or a rear suspension system, as described above. Each operation-enacting device **304** may include at least one movable component **311** configured to modify an operative state of the bicycle. Each operation-enacting device of the plurality of operation-enacting devices **304** includes a processor **304***c* and may include a memory **304***d*. At least some operation-enacting devices **304** of the plurality of operation-enacting devices **304** may be or include controller devices **302**, respectively.

In some cases, an operation-enacting device **304** may act on more than one component of the bicycle in a single operation. In other cases, a single operation may include more than one act on one or more components of the bicycle. In yet other cases, the operation may include a physical action and a wireless action, where the wireless action sends wireless signals to cause further action by other cooperative device(s).

The system **300** also includes a network coordinator device **306**. The network coordinator device **306** includes a first communication interface **306***a* configured to communicate wirelessly with the controller devices **302** and the plurality of operation-enacting devices **304**. Using the first communication interface **306***a*, the network coordinator device **306** may establish a wireless network **308** that enables communications between the network coordinator device **306**, the controller devices **302**, and the plurality of operation-enacting devices **304**. Correspondingly, each controller device **302** includes a communication interface **302***c* and each operation-enacting device **304** includes a communication interface **304***a* for communicating with other devices (e.g., receiving and transmitting data/signals) on the wireless network **308**. Each of the communication interfaces **304** may be or include any number of different types of receivers. In one embodiment, each of the communication interfaces **304** is or includes a combined transmitter and receiver. The network coordinator device **306** further includes a processor **306***d* and may include a memory **306***e*.

In the embodiment shown in FIG. **3**, the network coordinator device **306** further includes a second communication interface **306***b* configured to communicate wirelessly with an external computing device **314**. The external computing device **314** may be, for example, a modem, a router, or a satellite, from which the network coordinate device **306** may receive location data. Using the second communication interface **306***b*, the network coordinator device **306** may establish a wireless network **308** that enables communications between the network coordinator device **306** and the external computing device **314**. The wireless network **308** may be any number of different types of wireless networks including, for example, a WiFi network or a global positioning system (GPS) network.

In other embodiments, the second communication interface **306***b* may be configured to communicate wirelessly with other external computing devices **314**. For example, the other external computing devices **314** may include a smart phone, a computing tablet, a laptop, a personal computer, or the like. In one embodiment, the external computing device **314** includes an application **316**, such as a mobile application, or other computer software.

The network coordinator device **306** may be any number of different types of computing devices including, for example, a head unit (e.g., the head unit **130** or the head unit **240**). Although the network coordinator device **306** may appear in FIG. **3** as a separate device, the features of a network coordinator device **306** in alternative embodiments may be provided by one or more of the other controller devices **302** and/or operation-enacting devices **304** such as a rear derailleur.

The processors **302***e*, **304***c*, **306***d*, for example, of the system **300** may include a general processor, digital signal processor, an application specific integrated circuit (ASIC), field programmable gate array (FPGA), analog circuit, digital circuit, combinations thereof, or other now known or later developed processor. The each of processors **302***e*, **304***c*, **306***d* may be a single device or combinations of devices, such as through shared or parallel processing.

The memory **304***d*, **306***e*, for example, of the system **300** may be any number of different types of memory. For example, such memory may be a volatile memory or a non-volatile memory. The memory may include one or more of a read only memory (ROM), random access memory (RAM), a flash memory, an electronic erasable program read only memory (EEPROM), or other type of memory. The memory may be removable from the corresponding device, such as a secure digital (SD) memory card. Computer memory includes any one or more of a computer-readable medium and other equivalents and successor media, in which data or instructions may be stored. In general, a computer-readable medium includes any medium that is capable of storing, encoding, or carrying a set of instructions for execution by a processor or that cause a computer system to perform any one or more of the methods or operations disclosed herein.

To power wireless communications and computer processing, the system **300** may include power supplies, which may be stored internal to the operating device or stored external to the operating device. The power supplies may include a combination of multiple batteries or other power providing devices. Specially fitted or configured battery types, or standard battery types such as CR **2012**, CR **2016**, and/or CR **2032** may be used. In some embodiments, the devices in a system are all individually powered (e.g., by a dedicated battery).

As described above, the embodiments employ communication interfaces (e.g., communication interfaces **302***c*, **304***a*, **306***a*, and **306***b*). Such communication interfaces are configured to send data such as identification data, sensor data, control signals, and/or commands to bicycle components.

The communication interfaces provide for wireless communications in any now known or later developed format. Although the present specification describes components and functions that may be implemented in particular embodiments with reference to particular standards and protocols, the invention is not limited to such standards and protocols. For example, standards for Internet and other packet switched network transmission (e.g., TCP/IP, UDP/IP, HTML, HTTP, HTTPS) represent examples of the state of the art. Such standards are periodically superseded by faster or more efficient equivalents having essentially the same functions. Accordingly, replacement standards and protocols having the same or similar functions as those disclosed herein are considered equivalents thereof.

The illustration or other representation of devices, such as the network coordinator devices **306**, the controller devices **302**, and the operation-enacting devices **304**, include (even if not expressly labeled) any combination of processor(s), memory device(s) (e.g., computer-readable media storing program instructions for execution by processor(s)), sensor (s), communication interface(s), and power supply necessary to achieve the disclosed features.

At least some controller devices **302** of the plurality of controller devices **302**, at least some operation-enacting devices of the plurality of operation-enacting device **304**, and the network coordinator device **306** are paired into the wireless network **308**, and a roster **310** is defined by the controller devices **302** and the operation-enacting devices **304** that have been paired to the wireless network **308** at the end of a pairing session.

In one embodiment, at least some controller devices **302** of the plurality of controller devices **302** and at least some operation-enacting devices of the plurality of operation-enacting device **304** are already paired into the wireless network **308**, and the network coordinator device **306** (e.g., the head unit **130** or the head unit **240**) is added (e.g., paired into the wireless network **308**) at a later time (e.g., when the head unit **130** or the head unit **240** is attached to the bicycle **100** or the bicycle **200**, respectively). In another embodiment, at least some controller devices **302** of the plurality of controller devices **302**, at least some operation-enacting devices of the plurality of operation-enacting devices **304**, and the network coordinator device **306** are already paired into the wireless network **306**, and a head unit (e.g., the head unit **130** or the head unit **240**) not acting as a network coordinator device is added (e.g., paired into the wireless network **306**) at a later time (e.g., when the head unit **130** or the head unit **240** is attached to the bicycle **100** or the bicycle **200**, respectively).

By fixing the roster **310**, the system **300** only includes the devices **302**, **304** selected by the user and/or automatically paired into the system **300**. The controller devices **302**, the operation-enacting devices **304**, and the network coordinator device **306** may be paired into the wireless network **308** using pairing input elements **302***d*, pairing input elements **304***b*, and pairing input element **306***c*, respectively. The pairing input elements **302***d* may be the same as or different than the input elements **302***a* of the controller devices **302**, respectively. In one embodiment, the controller devices **302**, the operation-enacting devices **304**, and the network coordinator device **306** are paired into the wireless network **308** without interaction with any input element. Instead, the controller devices **302**, the operation-enacting devices **304**, and the network coordinator device **306** are automatically paired into the wireless network **308**.

When the pairing session ends, the network coordinator device **306** is configured to transmit, to the operation-enacting devices **304**, the roster **310** identifying the controller devices **302** and the operation-enacting devices **304** paired to the wireless network **308**. The operation-enacting devices **304** are configured to determine, based on the roster **310** received from the network coordinator device **306**, how to enact operations in response to the signals **302***b* received from the controller devices **302**.

The operation-enacting devices **304** are configured to process a default set of assignments **312** based on the roster

310 to determine how the operation-enacting devices 304 enact the operations responsive to the signals 302*b*. The default set of assignments 312 may be transmitted to each operation-enacting device 304 by the network coordinator device 306, and/or stored locally on each operation-enacting device 304.

For example, after a pairing session is completed, the roster 310 may include a right controller device with a right shift lever, a left controller device with a left shift lever, a front derailleur, and a rear derailleur. The default set of assignments 312 controlling the operation of the operation-enacting devices 304 is determined according to the particular set of devices in the roster 310. Modified assignments 312' may be defined by the external computing device 314 and transmitted to, for example, the network coordinator device 306.

FIG. 4 illustrates another embodiment of a controller device 400. The controller device 400 may be a controller device of the plurality of controller devices 302, an operation-enacting device of the plurality of operation-enacting devices 304, the network coordinator device 306, or the head unit (e.g., the head unit 130 or the head unit 240).

The controller device 400 includes, for example, a processor 400*a*, a memory 400*b*, and a first communication interface 400*c*. The processor 400*a*, the memory 400*b*, and the first communication interface 400*c* may be supported by and in communication with each other via, for example, a printed circuit board (PCB). The PCB may be supported by a housing 402.

The processor 400*a* may include a general processor, digital signal processor, an application specific integrated circuit (ASIC), field programmable gate array (FPGA), analog circuit, digital circuit, combinations thereof, or other now known or later developed processor. The processor 400*a* may be a single device or combinations of devices, such as through shared or parallel processing.

The memory 400*b* may be any number of different types of memory. For example, such memory may be a volatile memory or a non-volatile memory. The memory may include one or more of a read only memory (ROM), random access memory (RAM), a flash memory, an electronic erasable program read only memory (EEPROM), or other type of memory. The memory may be removable from the corresponding device, such as a secure digital (SD) memory card. Computer memory includes any one or more of a computer-readable medium and other equivalents and successor media, in which data or instructions may be stored. In general, a computer-readable medium includes any medium that is capable of storing, encoding or carrying a set of instructions for execution by a processor or that cause a computer system to perform any one or more of the methods or operations disclosed herein.

The first communication interface 400*c* provides for wireless communications in any now known or later developed format. Although the present specification describes components and functions that may be implemented in particular embodiments with reference to particular standards and protocols, the invention is not limited to such standards and protocols. In one embodiment, the controller device 400 includes a second communication interface 400*e* configured to communicate using a different standard or protocol compared to the first communication interface 400*c*.

The controller device 400 may include one or more additional components supported by the housing 402 and in communication with the processor 400*a*, the memory 400*b*, the first communication interface 400*c*, and/or the second communication interface 400*e* via the PCB. For example, the controller device 400 may also include an energy storage device 400*d* (e.g., power supply), one or more sensors 400*f*, and/or power management electronics.

The energy storage device 400*d* may include one or more batteries or other power providing devices. Specially fitted or configured battery types, or standard battery types such as CR 2012, CR 2016, and/or CR 2032 may be used.

The one or more sensors 400*f* may include any number of different types of sensors. For example, the one or more sensors 400*f* may include a velocity sensor, an acceleration sensor (e.g., an accelerometer), and/or a pressure sensor.

Wireless communication between components is described herein. Although the present specification describes components and functions that may be implemented in particular wireless communication embodiments with reference to particular standards and protocols, the invention is not limited to such standards and protocols. For example, standards for Internet and other packet switched network transmission (e.g., TCP/IP, UDP/IP, HTML, HTTP, HTTPS) represent examples of the state of the art. Such standards are periodically superseded by faster or more efficient equivalents having essentially the same functions. Accordingly, replacement standards and protocols having the same or similar functions as those disclosed herein are considered equivalents thereof.

In an embodiment, components of the bicycle described herein will communicate with each other. In the case of wireless communication, the components will initially be paired so as to allow secure communication between components on the bicycle without interference from devices not associated with the system. Next, one or more of the components may be paired with a separate device like a computer, tablet, or phone. This paired device may provide the user interface to allow the user to communicate with the components on the bicycle 0. Examples of communication are updating firmware, setting variables, and running diagnostic tools and analysis.

FIG. 5 shows an example of a system 500 for controlling a combination of operation-enacting devices on a bicycle. The system includes a first controller device 502*a* (e.g., a left shift controller; a first controller device 302) and a second controller device 502*b* (e.g., a right shift controller; a second controller device 302). The system 500 also includes a plurality of operation-enacting devices 504. For example, the plurality of operation-enacting devices 504 includes a front derailleur 504*a* and a rear derailleur 504*b*.

The system 500 also includes a computing device 506 (e.g., a head unit; a network coordinator device 306) that is in communication with the first controller device 502*a*, the second controller device 502*b*, the front derailleur 504*a*, and the rear derailleur 504*b*. For example, the computing device 506 includes one or more communication interfaces (e.g., including a first wireless communication interface) via which the computing device 506 may wirelessly communicate with at least one of the other components of the system 500.

The system 500 may include more, fewer, and/or additional components. For example, the system 500 may include a power source 508 (e.g., a battery) and an antenna 510 (e.g., a radio). The power source 508 and/or the antenna 510 may be part of one of the other components of the system 500 (e.g., part of the rear derailleur 504*b*) or may be separate from the other components of the system 500. In the embodiment shown in FIG. 5, the system 500 includes the antenna 510, and the computing device 506 communicates with the other components of the system 500 via the antenna 510.

In the embodiment shown in FIG. **5**, the first controller device **502***a*, the second controller device **502***b*, the front derailleur **504***a*, the rear derailleur **504***b*, the battery **508**, and the antenna **510** are in communication with each other via wired connections, and these wired components are in wireless communication with the computing device **506** via the antenna **510**. Other configurations may be provided.

For example, FIG. **6** shows another example of a system **600** for controlling a combination of operation-enacting devices on a bicycle. The system **600** includes a first controller device **602***a* (e.g., a left shift controller; a first controller device **302**) and a second controller device **602***b* (e.g., a right shift controller; a second controller device **302**). The system **600** also includes a plurality of operation-enacting devices **604**. For example, the plurality of operation-enacting devices **604** includes a front derailleur **604***a* and a rear derailleur **604***b*.

The system **600** also includes a computing device **606** (e.g., a head unit; a network coordinator device **306**) that is in communication (e.g., direct communication) with the first controller device **602***a*, the second controller device **602***b*, and the rear derailleur **604***b*. For example, the computing device **606** includes one or more communication interfaces (e.g., including a first wireless communication interface) via which the computing device **606** may wirelessly communicate with at least one of the other components of the system **600**. The system **600** may include more, fewer, and/or different components. For example, the system **600** may also include a battery **608**.

In the embodiment shown in FIG. **6**, the rear derailleur **604***b*, for example, may include an antenna. The front derailleur **604***a*, the rear derailleur **604***b*, and the battery **608** are in communication with each other via wired connections, and these wired components are in wireless communication with, for example, at least the computing device **606** via the antenna of the rear derailleur **604***b*. Other configurations may be provided. For example, the wired components may also be in wireless communication with the first controller device **602***a* and the second controller device **602***b* via the antenna of the rear derailleur **604***b*.

As another example, FIG. **7** shows yet another example of a system **700** for controlling a combination of operation-enacting devices on a bicycle. The system **700** includes a first controller device **702***a* (e.g., a left shift controller; a first controller device **302**) and a second controller device **702***b* (e.g., a right shift controller; a second controller device **302**). The system **700** also includes a plurality of operation-enacting devices **704**. For example, the plurality of operation-enacting devices **704** includes a front derailleur **704***a*, a rear derailleur **704***b*, and a seatpost assembly **704***c*.

The system **700** also includes a computing device **706** (e.g., a head unit; a network coordinator device **306**) that is in communication (e.g., direct communication) with the first controller device **702***a*, the second controller device **702***b*, the front derailleur **704***a*, the rear derailleur **704***b*, and the seatpost assembly **704***c*. For example, the computing device **706** includes one or more communication interfaces (e.g., including a first wireless communication interface) via which the computing device **706** may wirelessly communicate with at least one of the other components of the system **700**. For example, the first controller device **702***a*, the second controller device **702***b*, the front derailleur **704***a*, the rear derailleur **704***b*, and the seatpost assembly **704***c* include antennas, respectively, and the computing device **706** may communicate with the first controller device **702***a*, the second controller device **702***b*, the front derailleur **704***a*, the rear derailleur **704***b*, and the seatpost assembly **704***c* via the antennas, respectively, and the first wireless communication interface of the computing device **706**. Other component configurations and/or communication configurations may be provided. For example, the system **700** may also include a power source (e.g., a battery) that powers, for example, the front derailleur **704***a* and the rear derailleur **704***b* via wired connections.

As illustrated in FIGS. **5-7**, different bicycles owned by a user of a head unit, for example, may have different component configurations. For example, the system **500** of FIG. **5** includes a separate antenna **510**, while the system **600** of FIG. **6** and the system **700** of FIG. **7** do not. Further, the first controller device **502***a*, the second controller device **502***b*, the front derailleur **504***a*, the rear derailleur **504***b*, and the battery **508** are wired components. Unlike the system **500** of FIG. **5**, the system **600** of FIG. **6** includes a wireless first controller device **602***a* and a wireless second controller device **602***b*. Unlike the system **500** of FIG. **5** and the system **600** of FIG. **6**, the system **700** of FIG. **7** includes the seat post assembly **704***c*, and the front derailleur **704***a* and the rear derailleur **704***b* are wireless. Based on these differences, the systems **500**, **600**, and **700** are unique and identifiable relative to each other.

FIG. **8** illustrates a method **800** for generating component datasets representing different bicycle systems (e.g., the system **500**, the system **600**, and the system **700**), respectively, to be used for detecting a unique bicycle, as discussed below with reference to FIG. **10**. The method **800** may be executed, for example, when electronic bicycle components of a bicycle are first paired into a network of the bicycle and/or when the bicycle enters a build bicycle mode. The acts of the method **800** presented below are intended to be illustrative. In some embodiments, the method **800** may be accomplished with one or more additional acts not described, and/or without one or more of the acts discussed. Additionally, the order in which the acts of the method **800** are illustrated in FIG. **8** and described below is not intended to be limiting.

In some embodiments, the method **800** may be implemented in one or more processing devices (e.g., digital processor, an analog processor, a digital circuit designed to process information, an analog-circuit designed to process information, a state machine, and/or other mechanisms for electronically processing information). The one or more processing devices include one or more devices executing some or all the acts of the method **800** in response to instructions stored electronically on an electronic storage medium. The one or more processing devices are configured through hardware, firmware, and/or software to be specifically designed for execution of one or more of the acts of the method **800**. As presented in the following, acts may be performed using any combination of the components indicated in FIGS. **1A-1E**, **2A-2C**, **3-7**, and/or other components.

In act **802**, a first processor initiates a mode (e.g., a build bicycle mode) for a bicycle. The first processor may be a processor of any number of different components (e.g., a first electronic component) of the bicycle. For example, the first processor may be a processor of a rear derailleur of the bicycle, a computing device of the bicycle (e.g., a head unit), or another electronic component of the bicycle.

The first electronic component (e.g., the head unit or the rear derailleur) may include any number of different components. For example, the first electronic component may include the first processor in communication with a communication interface (e.g., a first communication interface), a memory (e.g., a first memory), and a sensor (e.g., a first

sensor) of the first electronic component. The first electronic component may include more, fewer, and/or different components.

The first processor may initiate the build bicycle mode based on user input or automatically. For example, the first processor may initiate the build bicycle mode based on one or more button presses on one or more electronic components of the bicycle (e.g., the first electronic component). Alternatively, the user may interact with the head unit (e.g., a touch screen of the head unit) or another computing device (e.g., a mobile phone) that is paired into a wireless network of the bicycle to initiate the build bicycle mode.

In one embodiment, the first processor may initiate the build bicycle mode automatically when electronic components of the bicycle are first powered on, when one or more of the electronic components are woken, when one or more of the electronic components are first paired into the wireless network or another wireless network on the bicycle, when an electronic component is added or removed from the wireless network or the other wireless network, and/or when the head unit is paired into the wireless network or the other wireless network.

In act **804**, a second component (e.g., a second electronic component of the bicycle) generates a signal (e.g., an identification signal). The second electronic component of the bicycle includes a processor (e.g., a second processor) and a communication interface (e.g., a second communication interface) in communication with the processor. The second electronic component may include more and/or different components. For example, the second electronic component may include a sensor (e.g., a second sensor) and a memory (e.g., a second memory) in communication with the second processor and the communication interface of the second electronic component. The second sensor may be, for example, an accelerometer.

The second electronic component of the bicycle may be any number of different types of electronic components. For example, the second electronic component may be a derailleur (e.g., a front derailleur), a seat post assembly, a control device, or another electronic component of the bicycle.

The accelerometer of the second electronic component, for example, or another sensor of the bicycle may sense when the second electronic component moves, and the second electronic component (e.g., the second processor and/or the second communication interface) may wake based on the sensed movement. The second electronic component (e.g., the second processor) may generate the signal in response to waking.

In another embodiment, the first electronic component (e.g., the first processor) may generate and transmit a signal in response to the initiation of the build bicycle mode in act **802** (e.g., a mode signal). The second electronic component may generate the identification signal in act **804** in response to receipt of the mode signal generated and transmitted by the first electronic component.

The second electronic component of the bicycle may be in a paired state or an unpaired state (e.g., with the first electronic component of the bicycle). When in the unpaired state, the processor of the second electronic device may generate the signal periodically (e.g., once every 0.1 s, 0.01 s, or 0.001 s) for a predetermined period of time. The signal may, for example, identify the second electronic component. For example, the signal may include data representing a type of bicycle component (e.g., "front derailleur") the second electronic component is and/or an identification number (e.g., a unique identification number) corresponding to the second electronic component. The signal may include additional, less, and/or different information.

In act **806**, the second electronic component transmits the signal generated in act **804**. The second electronic component may transmit the signal generated in act **804** via, for example, the second communication interface. In one embodiment, in the unpaired state, the second electronic component may not transmit the signal generated in act **804** to a particular destination. In another embodiment, in the paired state, the second electronic component may transmit the signal generated in act **804** to the first electronic component.

In act **808**, the first electronic component receives the signal transmitted by the second electronic component in act **806**. The first electronic component receives the signal transmitted by the second electronic component via, for example, the first communication interface. When the first electronic component is in the unpaired state, the first electronic component may listen for signals and/or messages from other electronic components of the bicycle (e.g., the second electronic component) and/or off the bicycle. For example, the first processor of the first electronic component may listen for and receive, via the first communication interface, the signal transmitted by the second electronic component in act **806**. The first electronic component may begin listening for the signals and/or the messages in response to the initiation of the build bicycle mode in act **802**.

In act **810**, the first electronic component (e.g., the first processor) determines whether the second electronic component is part of the bicycle. In one embodiment, the first electronic component may determine whether the second electronic component is part of a network of the bicycle instead of determining whether the second electronic component is part of the bicycle.

As an example, the first processor initiates generation and display (e.g., at the head unit) of a representation of the second electronic component (e.g., the bicycle component type and/or the identification number) based on the signal received in act **808**, and the user confirms or rejects the second electronic component being part of the bicycle (e.g., at the head unit). As another example, the first processor initiates the generation of a visual signal (e.g., a blinking light) or an audio signal (e.g., one or more tones) at the second electronic component in response to the signal received in act **808**, and the user confirms the second electronic component is part of the bicycle by, for example, pressing a button in response to the visual signal or the audio signal at the second electronic component. In other words, the first electronic component determines the second electronic component is part of the bicycle based on user input at the first electronic component, the second electronic component, the head unit, another computing device in communication with the first electronic component, and/or another component of the bicycle.

If the first processor determines the second electronic component is part of the bicycle, the method **800** moves to act **812**. If the first processor determines the second electronic component is not part of the bicycle, the method **800** returns to act **804**, and acts **804-810** may be repeated for one or more additional components (e.g., a third electronic component of the bicycle).

In act **812**, the first processor adds data from the signal received in act **808** to a dataset corresponding to the bicycle (e.g., representing a bicycle system). For example, the dataset corresponding to the bicycle is stored in the first memory of the first electronic component, the second

memory of the second electronic component, a memory of the head unit, a memory of another computing device (e.g., a mobile phone), and/or another memory (e.g., a memory within the Cloud).

When the bicycle build mode is initiated in act **802**, the user may assign a name to the bicycle system (e.g., the dataset corresponding to the bicycle system) being built in the method **800**. For example, the user may interact with, for example, the head unit, the first electronic component, a computing device (e.g., a mobile phone) in communication with the first electronic component, and/or another computing device to assign the name to the bicycle system. For example, referring to FIG. **9**, for the first bicycle system being built within the bicycle build mode initiated in act **802**, the user may assign a bicycle name of "TT road bike." In one embodiment, the first processor automatically assigns a name based on types of electronic components identified during the method **800** (e.g., road bicycle components, gravel bicycle components, or mountain bicycle components).

In act **812**, the first processor, for example, may add the data from the signal received in act **808** to the dataset corresponding to the bicycle, which includes the user assigned bicycle name. The dataset corresponding to the bicycle may be stored within a table (e.g., within a row of the table or a column of the table; a first table). For example, the dataset corresponding to the "TT road bike" may be stored in a row of the table stored in the memory.

FIG. **9** also shows additional bicycle systems built within the bicycle build mode using the method **800** with the bicycle names of "gravel bike," and "mountain bike," respectively. Any number of other names may be assigned to any number of additional, fewer, and/or different bicycle systems built in the bicycle build mode.

Additionally or alternatively, the first processor, for example, may automatically assign a name to the bicycle system being built in the bicycle build mode of act **802**, and the dataset corresponding to the bicycle may also include the automatically assigned name for the bicycle (e.g., stored in the row of the table stored in the memory). Referring to FIG. **9**, the first processor, for example, may automatically assign a "Bike ID" based on how many different bicycle systems the user has built using the method **800** (e.g., how many datasets corresponding to different bicycle systems have been saved to the memory using the bicycle build mode initiated in the method **800**). For example, the first bicycle system built by the user using the method **800** may be assigned a "Bike ID" of "bike_1," and "bike_1" may be stored with the name of the bicycle system assigned by the user (e.g., "TT road bike").

The data from the signal added, in act **812**, to the dataset corresponding to the bicycle may include, for example, the bicycle component type and/or the identification number for the second electronic component. For example, referring to FIG. **9**, when the second electronic component is, for example, a front derailleur, the signal transmitted by the second electronic component in act **806** and received by the first electronic component in act **808** may include identification data of "front_derailleur_659." The identification data included within the signal received by the first electronic component in act **808** may identify the type of the electronic component, a front derailleur, and may include a unique identification number, 659. Additional, less, and/or different identification data may be included within the signal received by the first electronic component in act **808**.

The identification data included within the signal (e.g., corresponding to the second electronic component) received by the first electronic component in act **808** may be stored in the row of the table stored in the memory corresponding to the bicycle system currently being built with the method **800**. For example, the identification data for the second electronic component, which is included in the first signal received by the first electronic component, may correspond to a "1st component ID" within the table stored in the memory.

In act **814**, the first processor determines whether the current bicycle system (e.g., corresponding to the bicycle) being built in the bicycle build mode initiated in act **802** is complete. In other words, the first processor determines whether any additional data (e.g., corresponding to additional electronic components of the bicycle) is to be added to the dataset representing the bicycle stored in the table (e.g., in the row of the table). The first processor may determine whether the current bicycle system being built is complete by identifying an elapsed time since a last received signal (e.g., identification signal) and comparing the elapsed time to a predetermined time period (e.g., 5 seconds, 10 seconds, 20 seconds, or 30 seconds). The first processor determines the current bicycle system being built is complete when the elapsed time is greater than the predetermined time period. Alternatively, the first processor may identify the current bicycle system being built is complete based on user input (e.g., a button press at one of the electronic components of the bicycle, such as the first electronic component, or user input at the head unit).

When the first processor determines the current bicycle system being built is complete, the method **800** moves to act **816**. In act **816**, the dataset corresponding to the bicycle (e.g., corresponding to the bicycle system currently being built) is saved. As discussed above, the dataset corresponding to the bicycle may be built (e.g., saved to the table) as signals are received from electronic components of the bicycle in act **808**. The dataset corresponding to the bicycle may be built within the table stored in the memory as the signals are received from the electronic components of the bicycle. In one embodiment, however, the memory stores the identification data for the electronic components of the bicycle, but the memory or another memory does not store the identification data for the electronic components of the bicycle as a corresponding dataset within the table until act **816** after the building of the current bicycle system (e.g., corresponding to the bicycle) in the bicycle build mode initiated in act **802** is complete.

In one embodiment, the identification data for the electronic components of the bicycle is collected (e.g., stored at the first memory of the first electronic component) during the bicycle build mode initiated in act **802** as the dataset corresponding to the bicycle, and the first electronic component, for example, transmits the dataset corresponding to the bicycle to a central storage location (e.g., the Cloud). A memory of the Cloud, for example, stores the table, and upon receipt of the dataset corresponding to the bicycle by the Cloud, the memory of the Cloud stores the dataset corresponding to the bicycle within the table (e.g., with a row or a column of a table).

The table may be associated with the user, and the user may enter the bicycle build mode initiated in act **802** for any number of bicycles. A row or a column of the table, for example, may be added each time the user initiates the bicycle build mode for a different bicycle.

If the first processor determines in act **814** that the current bicycle system (e.g., corresponding to the bicycle) being built is not complete (e.g., other electronic components are to be added; additional signals are being generated by other

electronic components and received by the first electronic component), the acts **804-814** may be repeated for any number of other electronic components (e.g., the third electronic component, such as a rear derailleur) of the bicycle. For example, referring to FIG. **9**, repeating the acts **804-814** for a rear derailleur of the bicycle, the identification data of "rear_derailleur_131" may be added to, for example, the dataset corresponding to the bicycle system currently being built (e.g., the corresponding row of the table).

In one embodiment, the acts **804-812** of the method **800** are repeated for a device off of the bicycle. For example, the first electronic component may receive auxiliary data from a device off the bicycle in repeated act **804**, and acts **806-812** may be repeated for the auxiliary data. The first electronic component may include another communication interface (e.g., a third communication interface) that is different than the communication interface (e.g., the first communication interface), via which the first electronic component communicates with, for example, the second electronic component. In other words, the first electronic component may receive the auxiliary data via a communication interface of the first electronic component that is different than the communication interface, via which the first electronic component communicates with other electronic components of the bicycle.

For example, the device off the bicycle is a WiFi router, a wireless access point (e.g., a WiFi access point), or a global positioning system (GPS) satellite or server. The auxiliary data may include location data or may include data or signals, based on which a location of the first electronic component may be determined. For example, the auxiliary data may include a name of a WiFi access point communicating with the first electronic component in the method **800**, a name of a WiFi network to which the first electronic component is connectable, or may include one or more GPS signals received by the first electronic component or another component of the bicycle for triangulation or trilateration of the first electronic component, for example. The auxiliary data may include more, less, and/or different location data identifying the location of the first component or based on which the location of the first component may be determined. The auxiliary data or location data determined based on the auxiliary data (e.g., a location determined based on triangulation or trilateration of the GPS signals) may be stored in a row or a column of the table, for example, as part of the dataset corresponding to the current bicycle system being built.

Once a plurality of bicycle systems (e.g., corresponding to a plurality of different bicycles) have been built using the method **800** of FIG. **8** or another method, and stored in the table, the table may be used, for example, in a method **1000** of FIG. **10**. The table then stores, for example, predetermined component datasets for a plurality of different bicycles, respectively. A head unit may be used on the plurality of different bicycles, and the head unit may determine on which bicycle of the plurality of different bicycle the head unit is installed based on the predetermined component datasets stored in the memory.

FIG. **10** illustrates a method **1000** for detecting a unique bicycle (e.g., corresponding to the system **500**, the system **600**, or the system **700**). The method **1000** may be executed, for example, when a head unit is first paired into a network of the bicycle, when electronic components of the bicycle are woken up (e.g., when the user shakes the bicycle and, based on sensor data identifying movement of the bicycle, the electronic components of the bicycle are woken up), once the user starts riding the bicycle (e.g., as the electronic components transmit data, including identification data, to the head unit over the course of a ride), and/or based on user input. The acts of the method **1000** presented below are intended to be illustrative. In some embodiments, the method **1000** may be accomplished with one or more additional acts not described, and/or without one or more of the acts discussed. Additionally, the order in which the acts of the method **1000** are illustrated in FIG. **10** and described below is not intended to be limiting.

In some embodiments, the method **1000** may be implemented in one or more processing devices (e.g., digital processor, an analog processor, a digital circuit designed to process information, an analog-circuit designed to process information, a state machine, and/or other mechanisms for electronically processing information). The one or more processing devices include one or more devices executing some or all the acts of the method **1000** in response to instructions stored electronically on an electronic storage medium. The one or more processing devices are configured through hardware, firmware, and/or software to be specifically designed for execution of one or more of the acts of the method **1000**. As presented in the following, acts may be performed using any combination of the components indicated in FIGS. **1A-1E**, **2A-2C**, **3-7**, and/or other components.

In act **1002**, a processor (e.g., a first processor) of a first electronic component of a bicycle identifies a plurality of predetermined datasets for a plurality of bicycles, respectively. In other words, the first processor of the first electronic component of the bicycle initializes a list of bicycles (e.g., representing the plurality of bicycles). For example, the first electronic component of the bicycle identifies a table associated with a user, and the table may store the predetermined datasets for the plurality of bicycles in separate rows or columns of the table, respectively. The plurality of predetermined datasets may have been previously generated and stored using, for example, the method **800** of FIG. **8**. Each predetermined dataset of the plurality of predetermined datasets includes identification data for at least one bicycle component of the respective bicycle. For example, the identification data identifies one or more unique bicycle components (e.g., a rear derailleur, a front derailleur, a first controller device, and a second controller device) for each bicycle of the plurality of bicycles. In one embodiment, at least some predetermined datasets of the plurality of predetermined datasets also include location data for the corresponding bicycles, respectively. The location data may identify, for example, storage locations for the corresponding bicycles, respectively.

The table, for example, may be stored in a memory of the first electronic component, and/or the table may be transmitted to the first electronic component from a remote memory (e.g., a memory of the Cloud). The first electronic component is, for example, a head unit, though the first electronic component may be other bicycle components. The head unit may be removable and may be installed on a bicycle of the plurality of bicycles or another bicycle (e.g., not represented in the table). The user may sign into the head unit (e.g., using a username and password), the head unit may transmit the username and the password to the Cloud, for example, and the Cloud may transmit the table to the head unit if the user associated with the username and the password, for example, matches the user associated with the table.

The head unit may include any number of components. For example, the head unit may include the first processor, a memory (e.g., a first memory), at least one communication

interface, and/or one or more other components. The head unit may include more, fewer, and/or different components. For example, the head unit may include a first communication interface configured to communicate with bicycle components of the bicycle, and a second communication interface configured to communicate with a computing device off of the bicycle (e.g., the Cloud and/or a mobile computing device).

In act **1004**, the head unit (e.g., the processor of the head unit) determines whether a new component signal has been received. In one embodiment, when the head unit, for example, is turned on, the processor of the head unit generates and transmits (e.g., via the first communication interface of the head unit) a signal requesting (e.g., a request signal) identification data from electronic components of the bicycle (e.g., from electronic components within a distance relative to the head unit). The head unit may be in an unpaired state with the electronic components of the bicycle and may thus transmit the request signal to no particular destination. The head unit, for example, may receive the new component signal via, for example, the first communication interface or the second communication interface of the head unit in response to the request signal transmitted by the head unit.

In other embodiments, the processor of the head unit, for example, may receive the new component signal without first transmitting the request signal. For example, each of one or more of the electronic components of the bicycle may generate and transmit a new component signal when woken and/or based on user input (e.g., a press of a button at the respective electronic component of the bicycle).

The new component signal may, for example, be from one of the electronic components of the bicycle. For example, the new component signal may include data representing a type of bicycle component (e.g., "front derailleur") the one electronic component is and/or an identification number (e.g., a unique identification number) corresponding to the one electronic component (e.g., identification data). The new component signal may include additional, less, and/or different information.

In one embodiment, the new component signal may be from a device off the bicycle. For example, the new component signal may include auxiliary data from a WiFi device (e.g., a WiFi access point or a WiFi router) or GPS satellites or servers. The new component signal may be from other devices off the bicycle. The auxiliary data may include location data or other data (e.g., GPS signals) that may be used to determine a location of the head unit, for example. In one embodiment, the auxiliary data includes a name of a WiFi access point or router, a name of a WiFi network to which the head unit, for example, is connectable (e.g., a WiFi network within range of the head unit), or GPS signals that may be used to determine location of the head unit, for example.

If the processor of the head unit determines, in act **1004**, that a new component signal has been received, the method **1000** moves to act **1006**. If the processor of the head unit determines, in act **1004**, that a new component signal has not been received, the method **1000** moves to act **1012**.

In act **1006**, the head unit (e.g., the processor of the head unit) determines whether the identification data included within the new component signal received in act **1004** is included in one or more datasets of the plurality of predetermined datasets (e.g., stored in the table) identified in act **1002**. For example, referring to the example of FIG. **9**, the new component signal received in act **1004** may include the identification data "rear_derailleur_607," which corresponds to "bike_2," or "gravel bike," in the table.

A same electronic component may be installed on multiple bicycles associated with the user (e.g., represented in the table). For example, the user may install a same type of rear derailleur (e.g., a same model manufactured by a same company) on multiple bicycles associated with the user. In one embodiment, the identification data for each of these rear derailleurs is different (e.g., unique).

In another embodiment, the identification data is the same for each of these rear derailleurs. In other words, the same identification data is stored in the table within different datasets of the plurality of predetermined datasets representing different bicycles of the plurality of bicycles. For example, referring to FIG. **9**, if the same type of rear derailleur is installed on the "bike_2," the "gravel bike," and "bike_3," the "mountain bike," the identification data for the rear derailleur received in act **1004**, for example, may be "rear_derailleur_607" for both "bike 2" and "bike 3." Accordingly, a single match of identification data with a dataset of the plurality of predetermined datasets in act **1006** may not be sufficient to identify a bicycle of the plurality of bicycles.

In one embodiment, when the new component signal received in act **1004** includes auxiliary data (e.g., data related to a location of the head unit), in act **1006**, the head unit may determine whether the auxiliary data is included in one or more datasets of the plurality of predetermined datasets (e.g., stored in the table) identified in act **1002**. For example, the head unit compares a name of a WiFi access point, a name of a WiFi router, a name of a WiFi network, a location such as an address included with the new component signal to the plurality of datasets to determine if there is a match. In one embodiment, the head unit (e.g., the processor of the head unit) calculates a location of the head unit, for example, based on the new component signal received in act **1004**, and compares the calculated location of the head unit to the plurality of predetermined datasets.

For example, the auxiliary data may include a plurality of GPS signals, and the head unit, for example, may triangulate or trilaterate a location (e.g., a longitude and a latitude) of the head unit. A match between the calculated location of the head unit and one or more predetermined datasets of the plurality of predetermined datasets may be identified when a difference between the calculated location of the head unit and a location included within a predetermined dataset of the plurality of predetermined datasets is less than a predetermined threshold difference. For example, a match between the calculated location of the head unit and a location included within the predetermined dataset may be identified when a difference between respective longitudes is less than a first predetermined threshold difference and a difference between respective latitudes is less than a second predetermined threshold difference.

If, in act **1006**, the head unit determines the identification data included within the new component signal received in act **1004** is included within one or more datasets of the plurality of predetermined datasets identified in act **1002**, the method **1000** moves to act **1008** (e.g., identifies a match). If, in act **1006**, the head unit determines the identification data included within the new component signal received in act **1004** is not included within one or more datasets of the plurality of predetermined datasets identified in act **1002**, the method **1000** moves to act **1012**.

In act **1008**, the head unit (e.g., the processor of the head unit) identifies one or more bicycles of the plurality of bicycles associated with the user based on the identified

match of act **1006**. Each dataset of the plurality of predetermined datasets may include identification data for one or more electronic components included on the bicycle represented by the respective dataset, and bicycle identification data for the bicycle represented by the respective dataset (e.g., "bike_2" and/or "gravel bike"). For example, referring to the example of FIG. **9**, with matched identification data of "rear_derailleur_607" (e.g., included within the new component signal received in act **1004** and a second dataset of the plurality of predetermined datasets), "bike_2" and/or "gravel bike" is identified from the plurality of predetermined datasets (e.g., the table) as corresponding to the matched identification data.

In one embodiment, two or more bicycles of the plurality of bicycles may be identified in act **1008**. For example, two or more datasets of the plurality of predetermined datasets may include the identification data included within the new component signal received in act **1004**.

In act **1010**, the head unit displays representations of the one or more bicycles identified in act **1008**. The head unit includes, for example, a display (e.g., a touchscreen), and the display of the head unit displays the representations of the one or more bicycles. The representations of the one or more bicycles may be included within a list displayed at the display of the head unit, for example. For example, the list displayed at the display of the head unit may include bicycle identification data (e.g., "bike_2" and/or "gravel bike") corresponding to the one or more bicycles identified in act **1008**.

Additional and/or different representations of the one or more bicycles identified in act **1008** may be displayed at the display of the head unit, for example. In one embodiment, the display of the head unit displays images instead of or in addition to the list. For example, the display of the head unit may display an image (e.g., a photograph or an icon) of "bike_2" instead of or in addition to the text "gravel bike," for example.

In act **1012**, the head unit (e.g., the processor of the head unit) determines whether a bicycle has been selected from the representations of the one or more bicycles displayed in act **1010**. The user may interact with the head unit, for example, to select one of the representations, and the head unit determines whether the bicycle has been selected from the representations of the one or more bicycles displayed in act **1010** based on whether and what user input is received. For example, the user may select one of the representations by interacting with the touch screen of the head unit, by interacting with (e.g., pressing) one or more buttons of the head unit or another component of the bicycle (e.g., a shifter), and/or via one or more other interactions with the head unit, and the processor of the head unit may generate a signal based on the user input (e.g., a user input signal). The processor of the head unit may then determine whether a bicycle has been selected from the representations of the one or more bicycles displayed in act **1010** based on the user input signal.

If, in act **1012**, the head unit determines a bicycle has been selected from the representations of the one or more bicycles displayed in act **1010**, the method **1000** moves to act **1014**. If, in act **1012**, the head unit determines a bicycle has not been selected from the representations of the one or more bicycles displayed in act **1010**, the method **1000** returns to act **1004**.

In act **1014**, the head unit (e.g., the processor of the head unit) configures components the bicycle based on the bicycle selected in act **1012**. The head unit, for example, may configure the bicycle after the head unit is paired into a network connecting the electronic components of the bicycle. For example, the memory of the head unit and/or one or more other memories (e.g., a memory of the Cloud) may store configuration data corresponding to the selected bicycle, and the head unit may identify the configuration data in response to the bicycle selection in act **1012**. For example, the head unit may retrieve at least some of the configuration data for the bicycle from the memory of the head unit and/or may request at least some of the configuration data for the bicycle from the Cloud.

The configuration data may include data (e.g., preferred settings) for any number of components of the bicycle. For example, the configuration data may include data for an initial setting for a rear derailleur, a front derailleur, a suspension, a seat post assembly, and/or one or more other components of the bicycle. Alternatively or additionally, the configuration data may identify parameters for automatic shifting, and/or may identify one or more sensors of the bicycles, from which data is to be tracked (e.g., saved) and/or displayed. The configuration data may include more, less, and/or different data.

When, in act **1012**, the head unit determines a bicycle has not been selected from the representations of the one or more bicycles displayed in act **1010**, and the method **1000** returns to act **1004**, acts **1004-1012** may be repeated for another new component signal (e.g., corresponding to a front derailleur) received by the head unit, for example. Acts **1004-1012** may be repeated any number of times for any number of received new component signals corresponding to any number of components (e.g., electronic components) of the bicycle.

In one embodiment, the list displayed at the display of the head unit, for example, is pared down as new component signals are received by the head unit and compared to the plurality of predetermined datasets. For example, after the first new component signal is received by the head unit and compared to the plurality of predetermined datasets, three datasets (e.g., corresponding to three different bicycles) of the plurality of predetermined datasets may be identified as including the identification data (e.g., corresponding to a type of rear derailleur) included in the first new component signal (e.g., identified as candidate bicycles). When a second new component signal is received by the head unit (e.g., in repeated act **1004**), the identification data included in the second new component signal is compared to, for example, the three datasets identified with the first new component signal. For example, two datasets (e.g., corresponding to two different bicycles) of the originally identified three datasets may include the identification data (e.g., corresponding to a type of front derailleur) included in the second new component signal. Acts **1004-1012** may be repeated until the list displayed at the display of the head unit is pared down to a single bicycle.

In another embodiment, acts **1004-1008** are repeated each time a new component signal is received by the head unit, and the list is not displayed (e.g., in act **1010**) until all new component signals have been received by the head unit. In other words, the list is not pared down as more new component signals are received.

FIG. **11** illustrates a method **1100** for detecting a unique bicycle (e.g., corresponding to the system **500**, the system **600**, or the system **700**) and a user profile (e.g., a first user profile; a first profile) for the unique bicycle. The method **1100** may be executed, for example, when a head unit is first paired into a network of the bicycle, when electronic components of the bicycle are woken up (e.g., when the user shakes the bicycle and, based on sensor data identifying movement of the bicycle, the electronic components of the

bicycle are woken up), once the user starts riding the bicycle (e.g., as the electronic components transmit data, including identification data, to the head unit over the course of a ride), and/or based on user input. In one embodiment, a first part of the method **1100** is executed when the head unit is first paired into the network of the bicycle, and a second part of the method **1100** is executed at a later time (e.g., in response to detection of a riding scenario, such as exceeding a predetermined speed). The acts of the method **1100** presented below are intended to be illustrative. In some embodiments, the method **1100** may be accomplished with one or more additional acts not described, and/or without one or more of the acts discussed. Additionally, the order in which the acts of the method **1100** are illustrated in FIG. **11** and described below is not intended to be limiting.

In some embodiments, the method **1100** may be implemented in one or more processing devices (e.g., a digital processor, an analog processor, a digital circuit designed to process information, an analog-circuit designed to process information, a state machine, and/or other mechanisms for electronically processing information). The one or more processing devices include one or more devices executing some or all the acts of the method **1100** in response to instructions stored electronically on an electronic storage medium. The one or more processing devices are configured through hardware, firmware, and/or software to be specifically designed for execution of one or more of the acts of the method **1100**. As presented in the following, acts may be performed using any combination of the components indicated in FIGS. **1**A-**1**E, **2**A-**2**C, **3**-**7**, and/or other components.

The acts of a first part of the method may correspond to the acts **1002**-**1014** of the method **1000** of FIG. **10**. For example, in act **1102**, a processor (e.g., a first processor) of a first electronic component of a bicycle identifies a plurality of predetermined datasets for a plurality of bicycles, respectively. In other words, the first processor of the first electronic component of the bicycle initializes a list of bicycles (e.g., representing the plurality of bicycles). For example, the first electronic component of the bicycle identifies a table (e.g., a first table) associated with a user. The table may store the plurality of predetermined datasets for the plurality of bicycles in separate rows or columns of the table, respectively. The plurality of predetermined datasets may have been previously generated and stored using, for example, the method **800** of FIG. **8**. Each predetermined dataset of the plurality of predetermined datasets includes identification data for at least one bicycle component of the respective bicycle. For example, the identification data identifies one or more unique bicycle components (e.g., a rear derailleur, a front derailleur, a first controller device, and a second controller device) for each bicycle of the plurality of bicycles.

In act **1104**, the first electronic component (e.g., a processor of a head unit) determines whether a new component signal has been received. The new component signal may, for example, be for one of the electronic components of the bicycle. For example, the new component signal may include data representing a type of bicycle component (e.g., "front derailleur") the one electronic component is and/or an identification number (e.g., a unique identification number) corresponding to the one electronic component (e.g., identification data).

If the processor of the head unit determines, in act **1104**, that a new component signal has been received, the method **1100** moves to act **1106**. If the processor of the head unit determines, in act **1104**, that a new component signal has not been received, the method **1100** moves to act **1112**.

In act **1106**, the head unit (e.g., the processor of the head unit) determines whether the identification data included within the new component signal received in act **1104** is included in one or more datasets of the plurality of predetermined datasets (e.g., the table) identified in act **1102**. For example, referring to the example of FIG. **9**, the new component signal received in act **1104** may include the identification data "rear_derailleur_607," which corresponds to "bike_2," or "gravel bike," in the table.

If, in act **1106**, the head unit determines the identification data included within the new component signal received in act **1104** is included within one or more datasets of the plurality of predetermined datasets identified in act **1102**, the method **1100** moves to act **1108** (e.g., identifies a match). If, in act **1106**, the head unit determines the identification data included within the new component signal received in act **1104** is not included within one or more datasets of the plurality of predetermined datasets identified in act **1102**, the method **1100** moves to act **1112**.

In act **1108**, the head unit (e.g., the processor of the head unit) identifies one or more bicycles of the plurality of bicycles associated with the user based on the identified match of act **1106** (e.g., "bike_2" and/or "gravel bike"). In act **1110**, the head unit displays representations of the one or more bicycles identified in act **1108** (e.g., within a list displayed at the display of the head unit).

In act **1112**, the head unit (e.g., the processor of the head unit) determines whether a bicycle has been selected from the representations of the one or more bicycles displayed in act **1110**. The user may interact with the head unit, for example, to select one of the representations, and the head unit determines whether the bicycle has been selected from the representations of the one or more bicycles displayed in act **1110** based on whether and what user input is received.

If, in act **1112**, the head unit determines a bicycle has been selected from the representations of the one or more bicycles displayed in act **1110**, the method **1100** moves to act **1114**. If, in act **1112**, the head unit determines a bicycle has not been selected from the representations of the one or more bicycles displayed in act **1110**, the method **1100** returns to act **1104**.

In act **1114**, the head unit (e.g., the processor of the head unit) configures the bicycle based on the bicycle selection in act **1112**. For example, types of information to be tracked and/or displayed at the head unit may be defined based on the bicycle selected in act **1112**. For example, a memory of the head unit and/or one or more other memories (e.g., a memory of the Cloud) may store configuration data corresponding to the selected bicycle, and the head unit may identify the configuration data in response to the bicycle selection in act **1112**.

The configuration data may include data (e.g., preferred settings) for any number of components of the bicycle. For example, the configuration data may include data for an initial setting for the head unit (e.g., what data to display), a rear derailleur, a front derailleur, a suspension, a seat post assembly, and/or one or more other components of the bicycle. The configuration data may include more, less, and/or different data.

When, in act **1112**, the head unit determines a bicycle has not been selected from the representations of the one or more bicycles displayed in act **1110**, and the method **1100** returns to act **1104**, acts **1104**-**1112** may be repeated for another new component signal (e.g., corresponding to a front derailleur) received by the head unit, for example. Acts **1104**-**1112** may

be repeated any number of times for any number of received new component signals corresponding to any number of components (e.g., electronic components) of the bicycle.

In act **1116**, the head unit (e.g., the processor of the head unit) determines if a plurality of profiles are defined for the bicycle selected in act **1112**. The memory of the head unit or another memory (e.g., a memory of the Cloud) may store one or more profiles for each bicycle of the plurality of bicycles represented by the plurality of predetermined datasets (e.g., within the first table), respectively.

The profiles may, for example, be stored in a second table. Referring to the example of FIG. **12**, when, for example, "bike_2" and/or "gravel bike" is selected in act **1112**, the head unit (e.g., the processor of the head unit) identifies that two profiles (e.g., "1st profile" and "2nd profile") are associated with the selected bicycle. When, for example, "bike_3" and/or "mountain bike" is selected in act **1112**, the head unit identifies that one profile (e.g., "1st profile") is associated with the selected bicycle.

Each of the profiles may specify data (e.g., types of data) to be displayed at the head unit. The types of data to be displayed may include any number of different types of data including, for example, a heart rate of the rider, power, a gear setting, an inclination of the bicycle, and/or one or more other types of data. The types of data to be displayed may include more, less, and/or different data.

Alternatively or additionally, the profiles may specify configuration data. The configuration data may be additional to or different than the configuration data identified in act **1114**. The configuration data may include data (e.g., preferred settings) for any number of components of the bicycle. For example, the configuration data may include data for a setting for a rear derailleur, a front derailleur, a suspension, a seat post assembly, and/or one or more other components of the bicycle. The configuration data may include more, less, and/or different data. Alternatively or additionally, the configuration data may identify parameters for automatic shifting, and/or may identify one or more sensors of the bicycles, from which data is to be tracked (e.g., saved) and/or displayed.

If, in act **1116**, the head unit determines that a plurality of profiles are defined for the bicycle selected in act **1112** (e.g., based on a number of profiles stored in the second table for the selected bicycle), the method **1100** moves to act **1118**. If, in act **1116**, the head unit determines that a plurality of profiles are not defined for the bicycle selected in act **1112**, the method **1100** moves to act **1124**.

In act **1118**, the head unit displays representations of the plurality of profiles identified in act **1116**. The display (e.g., a touchscreen) of the head unit, for example, displays the representations of the plurality of profiles. The representations of the plurality of profiles may be included within a list displayed at the display of the head unit, for example. For example, with reference to the example of FIG. **12**, when, for example, "bike_2" and/or "gravel bike" is selected in act **1112**, the head unit may display the representations of the "1st profile" and "2nd profile" within the list at the display of the head unit. The head unit may display more and/or different information than the "1st profile" and "2nd profile" within the list. For example, information that allows the user to identify a rider, a riding scenario, and/or displayed types of data associated with the "1st profile" and "2nd profile," for example, may be displayed within the list. For example, the list displayed at the display of the head unit may include "1st profile—flat" and "2nd profile—hills," or may include "1st profile—Bob" and "2nd profile—Mary." Other information may be included within the representations.

Additional and/or different representations of the plurality of profiles identified in act **1116** may be displayed at the display of the head unit, for example. In one embodiment, the display of the head unit displays images instead of or in addition to the list. For example, the display of the head unit may display an image (e.g., a photograph or an icon) of a rider associated with the "1st profile" (e.g., a picture of Bob) and an image (e.g., a photograph or an icon) of a rider associated with the "2nd profile" (e.g., a picture of Mary) instead of or in addition to the text "1st profile" and "2nd profile," respectively.

In act **1120**, the head unit (e.g., the processor of the head unit) determines whether a profile has been selected from the representations of the plurality of profiles displayed in act **1118**. The user may interact with the head unit, for example, to select one of the representations, and the head unit determines whether the profile has been selected from the representations of the plurality of profiles displayed in act **1118** based on whether and what user input is received. For example, the user may select one of the profiles by interacting with the touch screen of the head unit, by interacting with (e.g., pressing) one or more buttons of the head unit or another component of the bicycle (e.g., a shifter), and/or via one or more other interactions with the head unit, and the processor of the head unit may generate a signal based on the user input (e.g., a user input signal). The processor of the head unit may then determine whether a profile has been selected from the representations of the plurality of profiles displayed in act **1118** based on the user input signal.

If, in act **1120**, the head unit determines a profile has been selected from the representations of the plurality of profiles displayed in act **1118**, the method **1100** moves to act **1122**. If, in act **1120**, the head unit determines a profile has not been selected from the representations of the plurality of profiles displayed in act **1118**, the method **1100** returns to act **1118** and waits for a selection (e.g., until a timeout).

In act **1122**, at least the head unit (e.g., the processor of the head unit) is configured (e.g., what data is to be displayed) based on the profile identified in act **1120**. For example, the head unit may be configured to display one or more different types of data (e.g., power generated from sensor data, a heart rate of the rider, a current gear) based on the profile identified in act **1120**.

Additionally or alternatively, the head unit may configure components the bicycle based on the profile identified in act **1120**. For example, the profile identified in act **1120** may include data (e.g., preferred settings) for any number of components of the bicycle. For example, the configuration data may include data for a setting for a rear derailleur, a front derailleur, a suspension, a seat post assembly, and/or one or more other components of the bicycle. At least some of the configuration data identified in act **1114** may be replaced by the configuration data identified in act **1122**.

Alternatively or additionally, the profile identified in act **1120** may identify parameters for automatic shifting, and/or may identify one or more sensors of the bicycle, from which data is to be tracked (e.g., saved) and/or displayed. The profile identified in act **1120** may include more, less, and/or different data.

In act **1124**, at least the head unit is configured (e.g., what data is to be displayed) based on the single profile identified in act **1116**. For example, the head unit may be configured to display one or more different types of data (e.g., power generated from sensor data, a heart rate of the rider, a current gear) based on the profile identified in act **1116**. Additionally or alternatively, the head unit may configure components of the bicycle, may identify parameters for automatic shifting,

and/or may identify one or more sensors of the bicycle, from which data is to be tracked (e.g., saved) and/or displayed based on the profile identified in act **1116**.

FIG. **13** illustrates a method **1300** for identifying a user profile (e.g., a second user profile; a second profile) for a bicycle that is already identified by a head unit. The method **1300** may be executed, for example, after the head unit is paired into a network of the bicycle and, for example, a rider has started riding the bicycle. In one embodiment, the method **1300** is executed after the method **1100** of FIG. **11**. For example, the method **1300** is executed in response to detection of a signature event (e.g., a personal or performance-based signature event; an operative state of the bicycle; in response to detection of a riding scenario, such as exceeding a predetermined speed). The acts of the method **1300** presented below are intended to be illustrative. In some embodiments, the method **1300** may be accomplished with one or more additional acts not described, and/or without one or more of the acts discussed. Additionally, the order in which the acts of the method **1300** are illustrated in FIG. **13** and described below is not intended to be limiting.

In some embodiments, the method **1300** may be implemented in one or more processing devices (e.g., a digital processor, an analog processor, a digital circuit designed to process information, an analog-circuit designed to process information, a state machine, and/or other mechanisms for electronically processing information). The one or more processing devices include one or more devices executing some or all the acts of the method **1300** in response to instructions stored electronically on an electronic storage medium. The one or more processing devices are configured through hardware, firmware, and/or software to be specifically designed for execution of one or more of the acts of the method **1300**. As presented in the following, acts may be performed using any combination of the components indicated in FIGS. **1A-1E**, **2A-2C**, **3-7**, and/or other components.

In one embodiment, acts of the method **1300** may be performed after act **1122** or act **1124** of the method **1100** have been performed. For example, the head unit (e.g., the processor of the head unit) may monitor sensor data generated by one or more sensors of the bicycle during a ride, and may identify another user profile (e.g., the second user profile) based on the monitored sensor data during the ride. In act **1302**, the head unit (e.g., the processor of the head unit) identifies sensor data from one or more sensors (e.g., of the bicycle; of one or more component of the bicycle). The sensor data may be transmitted from the one or more sensors to the head unit, or may be stored in a memory (e.g., of a component of the bicycle) and retrieved from the memory by the head unit.

The one or more sensors may include any number of sensors configured to sense any number of different types of data. For example, the one or more sensors may include a power meter of the bicycle, and the sensed data may include output power data (e.g., at a crankshaft of the bicycle). As another example, the one or more sensors may include a pressure sensor of a seatpost system (e.g., a seatpost assembly), and the sensed data may include pressure data within the seatpost system. As yet another example, the one or more sensors may include an accelerometer, and the sensed data may include acceleration data and/or velocity data (e.g., for the bicycle). As another example, the one or more sensors may include a gyroscope, and the sensed data may include inclination data (e.g., for the bicycle). The one or more sensors may include additional, fewer, and/or different sensors.

In act **1304**, the head unit (e.g., the processor of the head unit) determines an operative state of the bicycle based on the sensor data identified in act **1302**. The operative state of the bicycle may relate to a configuration of a component of the bicycle, a speed, acceleration, and/or orientation of the bicycle, and/or a rider of the bicycle (e.g., how much pressure is being applied to a seat of the seatpost system).

As an example, the head unit may determine an output power being applied by the rider based on the sensor data identified in act **1302** (e.g., the output power data). As another example, the head unit may determine a pressure applied to the seat of the seatpost system (e.g., corresponding to a weight of the rider) based on the sensor data identified in act **1302** (e.g., the pressure data). As yet another example, the head unit may determine a speed and/or an acceleration of the bicycle based on the sensor data identified in act **1302** (e.g., the acceleration data and/or the velocity data). As another example, the head unit may determine an inclination of the bicycle based on the sensor data identified in act **1302** (e.g., the inclination data).

Additional and/or different operative states of the bicycle may be determined. For example, the one or more sensors may track inclination of the bicycle over a predetermined period of time to identify an operative state of the bicycle being ridden on an uneven surface (e.g., a trail) or on hills. For example, the head unit (e.g., the processor of the head unit) may determine the operative state of the bicycle being ridden on the uneven surface based on a change of the inclination and/or a number of times the inclination of the bicycle changes by at least a particular angle over the predetermined period of time.

As another example, the one or more sensors may track the output power being applied by the rider of the bicycle over a predetermined period of time to identify the rider being engaged in interval training (e.g., cyclical increasing and decreasing of output power). For example, the head unit (e.g., the processor of the head unit) may determine the operative state of the rider being engaged in interval training based a number of times the output power being applied by the rider of the bicycle changes by at least a particular amount over the predetermined time period.

In act **1306**, the head unit (e.g., the processor of the head unit) identifies a profile (e.g., the second profile) from a plurality of profiles (e.g., stored at the memory or another memory, such as of the Cloud) based on the operative state of the bicycle determined in act **1304**. The second profile may supplement and/or at least partially replace the identified first profile. For example, the first profile (e.g., identified in the method **1100** of FIG. **11**) may be a rider profile that corresponds to a particular rider of the bicycle, and the second profile (e.g., identified in the method **1300** of FIG. **13**) may be a riding profile that corresponds to an operative state of the bicycle. In one embodiment, the head unit identifies two or more profiles from the plurality of profiles in act **1306**.

As discussed above, the memory of the head unit or another memory (e.g., a memory of the Cloud) may store one or more profiles for each bicycle of the plurality of bicycles represented by the plurality of predetermined datasets (e.g., within the first table), respectively. The head unit may identify the profile from the plurality of profiles stored in the second table, for example. In one embodiment, the head unit identifies the profile from a plurality of profiles of another table (e.g., a third table) stored in the memory or another memory (e.g., of the Cloud).

As discussed above, the profiles may, for example, specify data (e.g., types of data) to be displayed at the head unit. The

types of data to be displayed may include any number of different types of data including, for example, a heart rate of the rider, power, a gear setting, an inclination of the bicycle, and/or one or more other types of data. The types of data to be displayed may include more, less, and/or different data. Also as discussed above, alternatively or additionally, the profiles may specify configuration data that may include, for example, data (e.g., preferred settings) for any number of components of the bicycle. For example, the configuration data may include data for a setting for the head unit (e.g., what data to display), a rear derailleur, a front derailleur, a suspension, a seat post assembly, and/or one or more other components of the bicycle. The configuration data may include more, less, and/or different data. Alternatively or additionally, the configuration data may identify parameters for automatic shifting, and/or may identify one or more sensors of the bicycles, from which data is to be tracked (e.g., saved) and/or displayed.

The profiles may also include, in addition to the specified data to be displayed and/or the configuration data, at least one signature event (e.g., a profile signature event corresponding to an operative state of the bicycle; a predetermined operative state of the bicycle) that identifies when a particular profile is to be presented to the user at the display of the head unit, for example, and/or automatically used to set the head unit and/or one or more other components of the bicycle.

In act **1306**, the head unit (e.g., the processor of the head unit) may compare the operative state of the bicycle determined in act **1304** to the signature events of the profiles of the second table, respectively, and identify a profile of the plurality of profiles based on the comparison. For example, referring to the example of FIG. **12**, after "bike_2," the "gravel bike," is selected (e.g., in act **1112** of the method **1100** of FIG. **11**) and the "1st profile" is selected (e.g., in act **1120** of the method **1100** of FIG. **11**), while the rider is on the ride, the head unit may determine, based on the operative state determined in act **1304**, the bicycle is being ridden on hills. The profile signature event of the "2nd profile" for the "gravel bike" may be "hills," and the head unit may identify a match of the operative state determined in act **1304** (e.g., the bicycle being ridden on hills) with the profile signature event of the "2nd profile" for the "gravel bike." Accordingly, the head unit may identify the "2nd profile" for the "gravel bike" from the plurality of profiles stored in the second table in act **1306**. In other riding scenarios and/or with other bicycles, the head unit may identify other matching operative states (e.g., determined in act **1304**) and profile signature events (e.g., identified in act **1306**) corresponding to other profiles of the plurality of profiles.

For example, the operative state of the bicycle determined in act **1304** may be defined by the sensor data identified in act **1302** (e.g., the operative state of a particular speed of the bicycle is defined by speed data identified from a speed sensor or calculated from acceleration data from an accelerometer). In act **1306**, the head unit may compare the sensor data identified in act **1302** or a value calculated from the sensor data to the profile signature events identified in act **1306**.

In one embodiment, in act **1302**, the head unit (e.g., the processor of the head unit), for example, identifies output power data from a power meter of the bicycle and, in act **1306**, compares the identified output power data with at least some of the profile signature events of the plurality of profiles. For example, a profile (e.g., the second profile) for a selected bicycle (e.g., "3rd profile" for the "TT road bike", "bike_2," of FIG. **12**) may include, as a profile signature event, an output power threshold (e.g., 200 W). The head unit may, in act **1306**, compare the output power data identified in act **1302** to profiles of the plurality of profiles (e.g., corresponding to the selected bicycle) that include a profile signature event related to output power threshold. The head unit may identify, in act **1306**, the profile (e.g., "3rd profile" for the "TT road bike" of FIG. **12**) from the plurality of profiles based on the comparison(s). For example, the head unit may identify the profile from the plurality of profiles when the output power data identified in act **1302** is greater than the output power threshold included, as a profile signature event, in the profile. In one embodiment, the head unit identifies the profile from the plurality of profiles when the output power data identified in act **1302** is less than the output power threshold included in the profile.

In another embodiment, in act **1302**, the head unit (e.g., the processor of the head unit), for example, identifies pressure data from a pressure sensor of the bicycle (e.g., a seatpost system of the bicycle) and, in act **1306**, compares the identified pressure data with at least some of the profile signature events of the plurality of profiles. For example, a profile (e.g., the second profile) for a selected bicycle may include, as a profile signature event, a pressure threshold. The head unit may, in act **1306**, compare the pressure data identified in act **1302** to profiles of the plurality of profiles (e.g., corresponding to the selected bicycle) that include a profile signature event related to a pressure threshold. The head unit may identify, in act **1306**, the profile from the plurality of profiles based on the comparison(s). For example, the head unit may identify the profile from the plurality of profiles when the pressure data identified in act **1302** is greater than the pressure threshold included, as a profile signature event, in the profile. In one embodiment, the head unit identifies the profile from the plurality of profiles when the pressure data identified in act **1302** is less than the pressure threshold included in the profile.

In yet another embodiment, in act **1302**, the head unit (e.g., the processor of the head unit), for example, identifies acceleration data from an acceleration sensor (e.g., an accelerometer) of the bicycle and. The head unit, for example, calculates a speed of the bicycle from the acceleration data (e.g., integrates values of the acceleration data over a predetermined period of time) as the operative state of the bicycle (e.g., in act **1304**), and compares the calculated speed with at least some of the profile signature events of the plurality of profiles. For example, a profile (e.g., the second profile) for a selected bicycle may include, as a profile signature event, a speed threshold. The head unit may, in act **1306**, compare the speed calculated in act **1304** to profiles of the plurality of profiles (e.g., corresponding to the selected bicycle) that include a profile signature event related to a speed threshold. The head unit may identify, in act **1306**, the profile from the plurality of profiles based on the comparison (s). For example, the head unit may identify the profile from the plurality of profiles when the speed calculated in act **1304** is greater than the speed threshold included, as a profile signature event, in the profile. In one embodiment, the head unit identifies the profile from the plurality of profiles when the speed calculated in act **1304** is less than the speed threshold included in the profile. Additional and/or different sensor data and/or calculated values may be compared to additional and/or different profile signature events.

In act **1308**, the head unit displays a representation of the profile identified in act **1306**. The display (e.g., a touchscreen) of the head unit, for example, displays the representation of the profile identified in act **1306**. In one embodiment, in which the head unit identifies two or more profiles

from the plurality of profiles in act **1306**, the head unit displays the two or more representations of the two or more profiles, respectively, within a list at the display of the head unit, for example.

In act **1310**, the head unit (e.g., the processor of the head unit) determines whether a profile has been selected from the representation(s) of the profile(s) displayed in act **1308**. The user may interact with the head unit, for example, to select a representation, and the head unit determines whether the profile has been selected from the representation(s) displayed in act **1308** based on whether and what user input is received. For example, the user may select the profile by interacting with the touch screen of the head unit, by interacting with (e.g., pressing) one or more buttons of the head unit or another component of the bicycle (e.g., a shifter), and/or via one or more other interactions with the head unit, and the processor of the head unit may generate a signal based on the user input (e.g., a user input signal). The processor of the head unit may then determine whether the profile has been selected from the representation(s) displayed in act **1308** based on the user input signal.

If, in act **1310**, the head unit determines a profile has been selected from the representation(s) displayed in act **1308**, the method **1300** moves to act **1312**. If, in act **1310**, the head unit determines a profile has not been selected from the representation(s) displayed in act **1308**, the method **1300** returns to act **1308** and waits for a selection (e.g., until a timeout).

In act **1312**, at least the head unit is configured (e.g., what data is to be displayed) based on the profile identified in act **1310**. For example, the head unit may be configured to display one or more different types of data (e.g., power generated from sensor data, a heart rate of the rider, a current gear) based on the profile identified in act **1310**. At least some of the data to be displayed, identified by the second profile selected in act **1310**, may be in addition to or may replace some or all of the data to be displayed identified by the first profile selected in the method **1100** of FIG. **11**.

For example, with reference to the example of FIG. **12** (e.g., the "1st profile" and the "second profile" for the "TT road bike"), the data to be displayed, as identified by the first profile, may include "power" and "gear," while the data to be displayed, as identified by the second profile, may include "power" and "heart rate." Accordingly, after the execution of the method **1300**, "power" may still be displayed, while "heart rate" replaces "gear."

Additionally or alternatively, the head unit may configure components of the bicycle based on the profile identified in act **1310** (e.g., the second profile). For example, the profile identified in act **1310** may include data (e.g., preferred settings) for any number of components of the bicycle. For example, the configuration data may include data for a setting for a rear derailleur, a front derailleur, a suspension, a seat post assembly, and/or one or more other components of the bicycle. At least some of the configuration data of the second profile selected in act **1310** may be in addition to or may replace some or all of the configuration data identified in, for example, act **1114** and/or act **1122** of the method **1100** of FIG. **11**.

Alternatively or additionally, the profile identified in act **1310** may identify parameters for automatic shifting, and/or may identify one or more sensors of the bicycle, from which data is to be tracked (e.g., saved) and/or displayed. The profile identified in act **1310** may include more, less, and/or different data.

In one embodiment, the method **1300** does not include act **1308**. Instead, the head unit automatically configures the head unit and/or one or more components of the bicycle based on the profile identified in act **1306**. The method **1300** may be repeated any number of times for any instance of an operative state of the bicycle (e.g., determined in a repeated act **1304**) matching a signature event of one or more profiles corresponding to a selected bicycle.

In accordance with various embodiments of the present disclosure, the methods described herein may be implemented with software programs executable by a computer system, such as the head unit **130** or the head unit **240**. Further, in an exemplary, non-limited embodiment, implementations can include distributed processing, component/object distributed processing, and parallel processing. Alternatively, virtual computer system processing can be constructed to implement one or more of the methods or functionalities as described herein.

The methods and techniques described herein may be implemented using hardware configurations described herein and one or more computer programs providing instructions for the hardware. A computer program (also known as a program, software, software application, script, or code) can be written in any form of programming language, including compiled or interpreted languages, and it can be deployed in any form, including as a standalone program or as a module, component, subroutine, or other unit suitable for use in a computing environment. A computer program does not necessarily correspond to a file in a file system. A program can be stored in a portion of a file that holds other programs or data (e.g., one or more scripts stored in a markup language document), in a single file dedicated to the program in question, or in multiple coordinated files (e.g., files that store one or more modules, sub programs, or portions of code). A computer program may be deployed to be executed on one computer or on multiple computers that are located at one site or distributed across multiple sites and interconnected by a communication network.

The processes and logic flows described in this specification can be performed by one or more programmable processors executing one or more computer programs to perform functions by operating on input data and generating output. The processes and logic flows may also be performed by, and the apparatus may also be implemented as, special purpose logic circuitry (e.g., a field programmable gate array (FPGA) or an application specific integrated circuit (ASIC)).

As used in this application, the term 'circuitry' or 'circuit' refers to all of the following: (a) hardware-only circuit implementations (such as implementations in only analog and/or digital circuitry) and (b) to combinations of circuits and software (and/or firmware), such as (as applicable): (i) to a combination of processor(s) or (ii) to portions of processor(s)/software (including digital signal processor(s)), software, and memory(ies) that work together to cause an apparatus, such as a mobile phone or server, to perform various functions) and (c) to circuits, such as a microprocessor(s) or a portion of a microprocessor(s), that require software or firmware for operation, even if the software or firmware is not physically present.

This definition of 'circuitry' applies to all uses of this term in this application, including in any claims. As a further example, as used in this application, the term "circuitry" would also cover an implementation of merely a processor (or multiple processors) or portion of a processor and its (or their) accompanying software and/or firmware. The term "circuitry" would also cover, for example and if applicable to the particular claim element, a baseband integrated circuit or applications processor integrated circuit for a mobile

computing device or a similar integrated circuit in server, a cellular network device, or other network device.

Processors suitable for the execution of a computer program include, by way of example, both general and special purpose microprocessors, and any one or more processors of any kind of digital computer. Generally, a processor receives instructions and data from a read only memory or a random access memory or both. The essential elements of a computer are a processor for performing instructions and one or more memory devices for storing instructions and data. Generally, a computer also includes, or be operatively coupled to receive data from or transfer data to, or both, one or more mass storage devices for storing data, e.g., magnetic, magneto optical disks, or optical disks. However, a computer need not have such devices. Moreover, a computer can be embedded in another device, e.g., a mobile telephone, a personal digital assistant ("PDA"), a mobile audio player, a Global Positioning System ("GPS") receiver, or a system control device **150** to name just a few. Computer readable media suitable for storing computer program instructions and data include all forms of non-volatile memory, media and memory devices, including by way of example semiconductor memory devices, e.g., EPROM, EEPROM, and flash memory devices; magnetic disks, e.g., internal hard disks or removable disks; magneto optical disks; and CD ROM and DVD-ROM disks. The processor and the memory can be supplemented by, or incorporated in, special purpose logic circuitry. In an embodiment, a system control device **150** is integrated with a mobile telephone, PDA, a mobile audio player, a GPS receiver, and communicates wirelessly with bicycle components to provide automatic mode control.

The illustrations of the embodiments described herein are intended to provide a general understanding of the structure of the various embodiments. The illustrations are not intended to serve as a complete description of all of the elements and features of apparatus and systems that utilize the structures or methods described herein. Many other embodiments may be apparent to those of skill in the art upon reviewing the disclosure. Other embodiments may be utilized and derived from the disclosure, such that structural and logical substitutions and changes may be made without departing from the scope of the disclosure. Additionally, the illustrations are merely representational and may not be drawn to scale. Certain proportions within the illustrations may be exaggerated, while other proportions may be minimized. Accordingly, the disclosure and the figures are to be regarded as illustrative rather than restrictive.

While this specification contains many specifics, these should not be construed as limitations on the scope of the invention or of what may be claimed, but rather as descriptions of features specific to particular embodiments of the invention. Certain features that are described in this specification in the context of separate embodiments can also be implemented in combination in a single embodiment. Conversely, various features that are described in the context of a single embodiment can also be implemented in multiple embodiments separately or in any suitable sub-combination. Moreover, although features may be described above as acting in certain combinations and even initially claimed as such, one or more features from a claimed combination can in some cases be excised from the combination, and the claimed combination may be directed to a sub-combination or variation of a sub-combination.

Similarly, while operations and/or acts are depicted in the drawings and described herein in a particular order, this should not be understood as requiring that such operations be performed in the particular order shown or in sequential order, or that all illustrated operations be performed, to achieve desirable results. In certain circumstances, multitasking and parallel processing may be advantageous. Moreover, the separation of various system components in the embodiments described above should not be understood as requiring such separation in all embodiments, and it should be understood that any described program components and systems can generally be integrated together in a single software product or packaged into multiple software products.

One or more embodiments of the disclosure may be referred to herein, individually and/or collectively, by the term "invention" merely for convenience and without intending to voluntarily limit the scope of this application to any particular invention or inventive concept. Moreover, although specific embodiments have been illustrated and described herein, it should be appreciated that any subsequent arrangement designed to achieve the same or similar purpose may be substituted for the specific embodiments shown. This disclosure is intended to cover any and all subsequent adaptations or variations of various embodiments. Combinations of the above embodiments, and other embodiments not specifically described herein, are apparent to those of skill in the art upon reviewing the description.

The Abstract of the Disclosure is provided to comply with 37 C.F.R. § 1.72(b) and is submitted with the understanding that it will not be used to interpret or limit the scope or meaning of the claims. In addition, in the foregoing Detailed Description, various features may be grouped together or described in a single embodiment for the purpose of streamlining the disclosure. This disclosure is not to be interpreted as reflecting an intention that the claimed embodiments require more features than are expressly recited in each claim. Rather, as the following claims reflect, inventive subject matter may be directed to less than all of the features of any of the disclosed embodiments. Thus, the following claims are incorporated into the Detailed Description, with each claim standing on its own as defining separately claimed subject matter.

It is intended that the foregoing detailed description be regarded as illustrative rather than limiting and that it is understood that the following claims including all equivalents are intended to define the scope of the invention. The claims should not be read as limited to the described order or elements unless stated to that effect. Therefore, all embodiments that come within the scope and spirit of the following claims and equivalents thereto are claimed as the invention.

The invention claimed is:

1. A controller device for a bicycle, the controller device comprising:

a communication interface configured to receive component data from another controller device of the bicycle; and

a processor in communication with the communication interface, the processor being configured to:

identify the bicycle based on the received component data;

identify sensor data from a sensor;

determine an operative state of the bicycle based on the identified sensor data; and

identify a user profile from a plurality of user profiles based on the determined operative state of the bicycle; and

a display in communication with the processor,

wherein the display is configured to display one or more predetermined types of data based on the identified user

profile, the processor is further configured to initiate configuration of one or more components of the bicycle based on the identified user profile, or a combination thereof.

2. The controller device of claim **1**, further comprising a memory configured to store the plurality of user profiles, each user profile of the plurality of user profiles identifying at least one predetermined type of data to be displayed, a configuration for at least one component of the bicycle, or a combination thereof.

3. The controller device of claim **2**, wherein each user profile of the plurality of user profiles also includes one or more predetermined operative states, and

wherein the identification of the user profile from the plurality of user profiles comprises:

comparison of the identified sensor data to the respective one or more predetermined operative states for the user profile; and

identification of the user profile from the plurality of user profiles based on the comparison.

4. The controller device of claim **3**, wherein the user profile is a profile specific to a particular rider of the bicycle, a profile specific to a riding scenario of the bicycle, or a profile specific to the particular rider and the riding scenario of the bicycle.

5. The controller device of claim **4**, wherein the sensor is a power meter of the bicycle, the identified sensor data includes output power data, and the respective one or more predetermined operative states for the user profile include a predetermined threshold output power,

wherein the comparison of the identified sensor data to the respective one or more predetermined operative states for the user profile comprises comparison of the output power data to the predetermined threshold output power, and

wherein the identification of the user profile from the plurality of user profiles based on the comparison comprises identification of the user profile from the plurality of user profiles when, based on the comparison, an output power of the output power data is greater than the predetermined threshold output power.

6. The controller device of claim **4**, wherein the sensor is a sensor of a seatpost system, the identified sensor data includes pressure data within the seatpost system, and the respective one or more predetermined operative states for the user profile includes a predetermined threshold pressure,

wherein the comparison of the identified sensor data to the respective one or more predetermined operative states for the user profile comprises comparison of a pressure of the pressure data within the seatpost system to the predetermined threshold pressure, and

wherein the identification of the user profile from the plurality of user profiles based on the comparison comprises identification of the user profile from the plurality of user profiles when, based on the comparison, the pressure within the seatpost system is greater than the predetermined threshold pressure.

7. The controller device of claim **4**, further comprising the sensor, the sensor including an accelerometer,

wherein the identified sensor data includes acceleration data from the accelerometer, and the respective one or more predetermined operative states for the user profile includes a predetermined threshold speed,

wherein the processor is further configured to determine a speed of the bicycle based on the acceleration data from the accelerometer,

wherein the comparison of the identified sensor data to the respective one or more predetermined operative states for the user profile comprises comparison of the determined speed of the bicycle to the predetermined threshold speed, and

wherein the identification of the user profile from the plurality of user profiles based on the comparison comprises identification of the user profile from the plurality of user profiles when, based on the comparison, the determined speed of the bicycle is greater than the predetermined threshold speed.

8. The controller device of claim **7**, wherein the controller device is a head unit for the bicycle.

9. The controller device of claim **1**, wherein the one or more predetermined types of data include power data, heart rate data for a user of the bicycle, a gearing of the bicycle, or any combination thereof.

10. The controller device of claim **1**, wherein the identified user profile is a riding profile,

wherein the processor is further configured to identify two or more user profiles of the plurality of user profiles based on the identified bicycle, the two or more user profiles being rider profiles,

wherein the display is further configured to display two or more respective representations of the two or more rider profiles,

wherein the processor is further configured to:

receive a user input selecting a representation of the displayed two or more respective representations, the selected representation corresponding to a rider profile of the two or more rider profiles, and

wherein the display is configured to display at least one predetermined type of data based on the selected rider profile, the processor is further configured to initiate configuration of at least one component of the bicycle based on the selected rider profile, or a combination thereof.

11. The controller device of claim **10**, wherein the rider profile is identified after the rider profile is selected.

12. A computer-implemented method for identifying a user profile from a plurality of user profiles associated with a bicycle, the computer-implemented method comprising:

receiving, by a processor of a head unit of the bicycle, component data from a controller device of the bicycle;

identifying, by the processor, the bicycle based on the received component data;

identifying, by the processor, at least one user profile of a plurality of user profiles based on the identified bicycle;

displaying, by a display in communication with the processor, at least one representation corresponding to the at least one user profile, respectively;

receiving, by the processor, a user input, the user input identifying a representation of the displayed at least one representation, the identified representation corresponding to a first user profile of the plurality of user profiles;

displaying, by the display, at least one predetermined type of data based on the identified first user profile, initiating configuration of at least one component of the bicycle based on the identified first user profile, or a combination thereof;

receiving, by the processor, sensor data from a sensor of the bicycle;

determining, by the processor, an operative state of the bicycle based on the identified sensor data;

identifying, by the processor, a second user profile from the plurality of user profiles based on the determined operative state of the bicycle; and

displaying one or more predetermined types of data based on the identified second user profile, initiating configuration of one or more components of the bicycle based on the identified second user profile, or a combination thereof.

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