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(54) **A SAFETY HELMET**

(57) A safety helmet for use during driving of motorized vehicles comprising:

- at least one heartbeat sensor for determination of presence of a user's heartbeat,
- at least one gyroscope for sensing tilt of the helmet,
- preferably a suitable sensor on a clip of the under-chin safety belt for determination of use of the under-chin safety belt,
- a battery,
- a central unit, comprising a microcontroller or a micro-processor module, on which a helmet program is run, which is arranged to ensure sensing and obtaining data from the sensors and the gyroscope as well as transmitting data between the helmet and a vehicle, and
- a wireless receiving-transmitting module for connection with the vehicle and/or a mobile application.

The helmet enables termination of vehicle operation once a pre-defined threshold speed is exceeded, said speed being at least 5 km/h. Until this speed is reached, the drive system of the vehicle operates normally regardless of the status of the helmet, particularly to ensure manoeuvring the vehicle in case of technical checkups, servicing or parking. The invention also relates to a process for limitation of the driving speed or termination of vehicle operation based on the determined use of the helmet (proper or not).

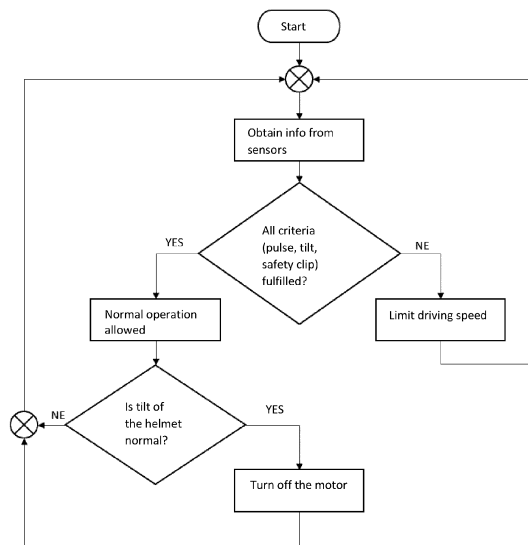


Figure 1

Description

Field of the invention

[0001] The present invention belongs to the field of human needs, namely helmets, more precisely to the field of safety helmets to be used in traffic. The invention also touches the field of vehicles, particularly controlling the driving speed, as well as the field of signalling and controlling based on specific values measured by sensors. The invention relates to a safety helmet and a process for termination of driving or limitation of driving speed during driving of electric or motorized two-, three- or four-wheeled vehicles based on use of the said safety helmet.

Background of the invention and the technical problem

[0002] Transportation means enable mobility of people worldwide and are also accessible to a wide population, from children to elderly. Driving transportation means having two, three or four wheels, for example motors, electric scooters, motorized bicycles, tricycles, and quads (ATV) require use of a certified safety helmet, which prevents injuries to the head or even death. However, the problem is that the helmets are not properly used, for example the helmet is held in hands, hanged on the steering, stored in a basket or a trunk, or worn on an elbow instead on the head, thus endangering the driver.

[0003] The technical problem, which is solved by the present invention, is thus to design of a safety helmet that will enable reliable control of helmet use and that will, at the same time, ensure a connection with a vehicle, operation of which will be dependent on the sensed proper use of the helmet. The aim and the purpose of the invention is consequently decreasing the number of injuries and improving the safety during driving of said vehicles.

State of the art

[0004] Utility model CN209473673 (U) discloses a fire-fighting helmet, which has a system for monitoring vital signs of a firefighter wearing the helmet, and means for connecting and sending data, which allows monitoring of the firefighter. The said helmet comprises a temperature sensor and a heartbeat sensor for checking vital signs of the firefighter, a gyroscope module, which follows movement of the firefighter. Data are sent via a microprocessor module and a wireless network transmission module to a central unit. This solution is not suitable for use in traffic and it does not allow any interaction with a drive of an electric and/or motorized vehicle.

[0005] Document CN110179195 describes a helmet for an electric bicycle, which can via a communication module connect to a system for controlling the driving speed of the electric bicycle. The helmet also has a system for checking proper use (Wear) of the helmet on a

person's head. In case a human body is detected, the signal is via the communication module sent to the control system and the electric bicycle can be driven with any speed allowed by the said bicycle. This solution does not describe the exact control system and the process for regulation of the driving speed.

[0006] Patent application EP0346300 describes a protective helmet, comprising power, sensors for normal use of the helmet, transmitter and an antenna, with which information about suitable use of the helmet is sent to the receiver installed in a vehicle. Ignition of the vehicle engine is possible if suitable use of the helmet is detected. In case sensors do not detect suitable wear, the vehicle cannot be moved, which is a disadvantage in case the vehicle has to be moved for few metres in a garage or to a vehicle service space or a space for a technical inspection.

[0007] The present invention differs from the above-mentioned documents in the components and the way of connection to the vehicle, driving of which is terminated in case of non-suitable helmet wear.

Description of the solution to the technical problem

[0008] The safety helmet according to the invention comprises a base moulding (mould) which fits to a user's head, an under-chin safety belt, suitable vibration absorbers arranged between the base mould and the user's head and optional visor and other common components of safety helmets for use in traffic. The essence of the helmet according to the invention is in that it further comprises:

- at least one heartbeat sensor for determination of presence of a user's heartbeat,
- at least one gyroscope for sensing tilt of the helmet,
- preferably a suitable sensor on a clip of the under-chin safety belt for determination of use of the under-chin safety belt,
- a battery for powering said sensors and the gyroscope, said battery being arranged for charging in any known manner and/or the battery uses replaceable batteries,
- a central unit, comprising a microcontroller or a microprocessor module, on which a helmet program is run, which is arranged to ensure sensing and obtaining data from the sensors and the gyroscope as well as transmitting data between the helmet and a vehicle,
- an optional mobile application, which monitors data sensed by said sensors and the gyroscope and is arranged to trigger termination of vehicle drive operation based on said data, and
- a wireless receiving-transmitting module for connection with the vehicle and/or the mobile application

[0009] The helmet according to the invention enables termination of vehicle operation, when the pre-defined

threshold speed of at least 5 km/h, preferably 10 km/h, is exceeded. Alternatively, the helmet can limit the driving speed up to the pre-defined threshold value, such as for example 5 km/h or 10 km/h. Thus, the user will not be able to drive faster until the helmet is not properly installed on the head. This is easier to achieve in vehicles having an electrical drive, vehicles with automatic gearbox, while this is more challenging in vehicles with internal combustion and/or manual gearbox. However, for the latter an in-built potentiometer for reading the position of the speed pedal, based on which the microprocessor can regulate speed. Until the pre-defined threshold speed is achieved, the drive system of the vehicle operates normally regardless of the use of the helmet, particularly to allow manoeuvring of the vehicle in case of technical inspection, servicing or parking.

[0010] The in-built heartbeat sensor is intended to ensure the helmet is properly installed and that it is placed on a human body (head) and not on a seat or in the trunk of the vehicle. The sensor may operate on the principle of optical transmitting and receiving diodes or on the principle of sensing electric pulses. The heartbeat sensor may be any suitable sensor known to the person skilled in the art of sensors, preferably the heartbeat sensor is an optical sensor operating on the principle of transmitting and receiving an amount of reflected light from the skin. Two or more sensors may be used, wherein the higher number of measurements ensures better reliability of the helmet. The sensor(s) is installed in the inner part of the helmet, preferably on the left and/or right temple. The tolerated range of the heartbeat is from 30 to 200 bpm, while any deviation from this range is detected with the safety helmet and reported to the central unit and the vehicle, which operation is then suitably adjusted in case the driving speed exceeds the pre-defined threshold value

- for example by termination of operation of engine electronics in the vehicle.

[0011] The gyroscope is preferably a combination of a rotation and acceleration sensor and is arranged to measure tilt of the helmet and reports if the helmet is suitably installed. The gyroscope and the battery, which is charged with a battery charger or with replaceable batteries, are installed in the helmet body, preferably in the front on the forehead or in the back on the head vertex. The safety helmet determines that the use is not proper, if the gyroscope senses a tilt into each direction of more than 90 degrees from the natural, i.e., upright position, when the helmet is properly installed on the head. Preferably a larger tilt is allowed, which may not last for more than a few seconds, for example 5 seconds, which can occur during an extreme leaning in road bends.

[0012] An additional and preferred part of the system for sensing proper use of the safety helmet is the sensor on the clip of the under-chin safety belt. This sensor may be either an electro-mechanical (switch, magnet) or an

opto-electric sensor. Any other sensor may be used, as long as it is arranged to be installed in the clip or beside the clip and allows sensing if both parts of the clip are clipped or not. Hence, if the helmet is not attached with the under-chin safety belt, the circuit is interrupted and the drive of the vehicle ceases to operate.

[0013] The central unit, which is a part of the helmet, comprises a microcontroller or a microprocessor module, on which the program of the helmet is run and ensures in data transfer and processing as well as data transfer between the helmet and the vehicle. A wireless receiving-transmitting module is intended for connection with the vehicle and/or the mobile application and is installed in the central unit or represents a separate unit. The antenna may be connected to the printed circuit or simply installed in the frame of the helmet. All currently known and future types of wireless connections and protocols may be used, for example standard connections as Bluetooth, Wi-Fi, ZigBee and similar. In case the mobile application is used, it has to be programmed in such a manner that it is arranged to check sensor-sensed parameters, perform suitable communication with the central unit of the helmet and the module of the vehicle, which controls the electronics, which are used for adjusting operation of the drive system of the vehicle.

[0014] The helmet is with the vehicle module or the vehicle connected with a wireless network, preferably Bluetooth network, as the connection is achieved using a password, thus preventing interruptions due to different connections. In the opposite case, each vehicle and each helmet should have a unique frequency in order to prevent cross-signalling. Preferably the mentioned module is installed in the steering part of the vehicle or on the dashboard. The module is powered in the vehicle with the vehicle's power, for example with an accumulator or a battery and similar, hence external power source is not needed. Alternatively, instead of the connection with the module, the helmet may be directly connected to the application, which is arranged to control the drive system of the vehicle, such as an electric scooter.

[0015] The safety helmet is through the wireless network connected with the mobile application or the vehicle module, which is connected to the drive aggregate of the vehicle, which is arranged to terminate driving or limit the driving speed upon sensed unsuitable use (wear) of the helmet, wherein termination or limitation of driving speed is achieved in the same way as if the user pressed the off-switch (button). Each electric vehicle comprises the microprocessor (or a microcontroller), which reads the position of the speed handle and with regards to its position, sends a suitable power to the electromotor via the controller. All that needs to be added to the system to be compatible with the helmet according to the invention is a wireless module through which communication with the helmet will be enabled and thus the impact on the operating state of the vehicle with respect to the sensed use of the helmet. The receiver or the module on the vehicle is connected to the control electronics of the vehicle and

in the event of a deviation from the predetermined parameters detected by the sensors, it is simply interrupted (in the embodiment where the engine is stopped). Alternatively, the module can be based on received data from the helmet define the power to be sent to the electromotor in order to achieve speed up to 10 km/h. Most of the vehicles, cars included, use CAN communication, however other protocols such as RS232, RS485, Ethernet and similar may be used.

[0016] The process of termination or limitation of the driving speed of a vehicle based on use of the above-described safety helmet according to the invention comprises the following steps:

- a) the helmet is wirelessly connected to the vehicle upon turning the vehicle on,
- b) the sensors and the gyroscope sense suitable wear (use) of the helmet, wherein:

- i. unsuitable use of the helmet is allowed when the driving speed is lower than the pre-set threshold value, which is preferably 5 km/h,
- ii. suitable use of the helmet allows ordinary driving (operation) of the vehicle,
- iii. unsuitable wear of the helmet at speeds higher than the pre-set threshold value, which is preferably 5 km/h, triggers turning off of the vehicle, so that the vehicle module connected to the electronics that control operation of the vehicle, interrupts the circuit of the drive system; or
- iv. unsuitable wear of the helmet at speeds higher than the pre-set threshold value, which is preferably 5 km/h, triggers limitation of the driving speed, so that the microcontroller (microprocessor) of the vehicle, which reads the position of the speed handle and with regards to the read position, a suitable power is given to the electromotor in order to limit the driving speed to maximum 10 km/h, preferably maximally 5 km/h.

[0017] Steps iii) and iv) are thus alternatives in operation. Preferably, after termination of driving, the vehicle is started normally, however, in case the helmet is again not properly installed, the driving may be terminated again or the driving speed may be limited again. The vehicle could, have an additional button for reset, which could set initial settings and vehicle start-up, however, this solution would further complicate operation of the present invention. In all cases the wireless safety module in the vehicle decides which mode of driving will be used (normal, limited, terminated).

[0018] The safety helmet according to the invention may be used in driving different vehicles, such as electric bicycles, scooters, motorized bicycles, motors, quads, tricycles and similar vehicles, which are driven by a drive system such as internal combustion engine, electric drive and all other possible drives. The helmet will prevent driving at a speed higher than the pre-set threshold speed,

preferably 10 km/h, in case that:

- the helmet will be on the user's arm - no heartbeat, the gyroscope senses an unsuitable tilt (rotation),
- the helmet is on the head, but the under-chin belt is not attached,
- the helmet is in the trunk - no heartbeat, or
- in any other case, in which one of the sensors senses a discrepancy from the pre-set threshold values.

[0019] Thus, the safety of the drivers and all other persons in the traffic will be significantly improved.

[0020] The safety helmet and a process for termination of driving or limitation of driving speed based on use of the said safety helmet will be described in further detail using figures, which show:

Figure 1 Diagram of operation of the invention and the process for limitation of the driving speed or termination of vehicle operation based on sensed use of the helmet according to the invention

Figure 2 A block diagram of a possible embodiment of helmet electronics

Figure 3 A block diagram of a possible embodiment of electronics in a vehicle

[0021] Figure 1 shows a diagram of operation of the invention and the process for limitation of the driving speed or termination of vehicle operation based on sensed use of the helmet according to the invention, which comprises a heartbeat sensor, a gyroscope and a sensor on a clip of an under-chin safety belt, wherein the said components are suitable installed in a basic mould of the helmet, while their status is monitored with a central unit or a microprocessor, respectively. In case a heartbeat is not detected and/or the gyroscope senses an unsuitable tilt and/or the clip of the under-chin safety belt is not closed, the helmet causes termination of driving via a wireless communication with a vehicle module, in case the driving speed exceeds the pre-defined threshold value, which is 5 km/h, or the helmet causes a limitation of the driving speed to maximally 10 km/h, preferably maximally 5 km/h. Even in case the helmet allows normal operation of the vehicle, termination of driving is still possible in case the gyroscope senses unsuitable values for too long or if the clip of the under-chin belt is opened.

[0022] Figure 2 shows a block diagram of a possible embodiment of the helmet electronics, while figure 3 shows a block diagram of a possible embodiment of vehicle electronics, wherein both wireless modules are arranged to wirelessly communicate.

Claims

1. A safety helmet comprising a base mould arranged to fit to a human head, an under-chin safety belt, suitable vibration absorbers provided between the

mould and the human head and an optional visor, **characterized in that** the helmet further comprises:

- at least one heartbeat sensor for determination of presence of a user's heartbeat,
- at least one gyroscope for sensing tilt of the helmet,
- preferably a suitable sensor on a clip of the under-chin safety belt for determination of use of the under-chin safety belt,
- a battery for powering said sensors and the gyroscope, said battery being arranged for charging in any known manner and/or the battery uses replaceable batteries,
- a central unit, comprising a microcontroller or a microprocessor module, on which a helmet program is run, which is arranged to ensure sensing and obtaining data from the sensors and the gyroscope as well as transmitting data between the helmet and a vehicle, and
- a wireless receiving-transmitting module for connection with the vehicle and/or a mobile application,

wherein the helmet enables termination of vehicle operation once a pre-defined threshold speed is exceeded, said speed being at least 5 km/h, preferably 10 km/h or more, or the helmet enables limitation of the driving speed to maximally 10 km/h, preferably to maximally 5 km/h.

2. The safety helmet according to claim 1, **characterized in that** the helmet further comprises a mobile application, which tracks the data sensed by both sensors and the gyroscope, wherein the application is arranged to trigger termination of operation of the drive system of the vehicle based on said data.
3. The safety helmet according to claim 1 or 2, **characterized in that** the heartbeat sensor is installed in the inner part of the helmet and operates on the principle of optical transmitting and receiving diodes or on the principle of sensing electric pulses, preferably the heartbeat sensor is an optical sensor operating on the principle of transmitting and receiving an amount of reflected light from the skin, wherein the tolerated range of the heartbeat is from 30 to 200 bpm.
4. The safety helmet according to the preceding claim, **characterized in that** the helmet comprises two or more heartbeat sensors.
5. The safety helmet according to any of the preceding claims, **characterized in that** the gyroscope is a combination of a rotation and acceleration sensor and the threshold tilt into each direction is more than 90 degrees from the natural, i.e., upright position,

when the helmet is properly installed on the head.

6. The safety helmet according to any of the preceding claims, **characterized in that** the sensor on the clip of the under-chin safety belt is either an electro-mechanical, i.e., switch, magnet, or an opto-electric sensor.
7. The safety helmet according to any of the preceding claims, **characterized in that** the central unit and the wireless receiving-transmitting module use any wireless connection and protocols, for example standard connections such as Bluetooth, Wi-Fi, and ZigBee.
8. The safety helmet according to any of the preceding claims, **characterized in that** the helmet is arranged for a wireless connection with a vehicle module, preferably Bluetooth, as the connection is achieved with a password, thus preventing interference between different connections.
9. The safety helmet according to any claim from 2 to 8, **characterized in that** the mobile application is programmed in such a way that it performs checking sensor-sensed parameters, suitable connection with the central unit of the helmet and the vehicle module controlling vehicle electronics, wherein operation status of the vehicle drive is adjusted based on sensed parameters.
10. A process of interruption or limitation of driving speed of a vehicle based on use of the safety helmet according to any of the preceding claims, wherein the process comprises the following steps:
 - a) the helmet is wirelessly connected to the vehicle upon turning the vehicle on,
 - b) the sensors and the gyroscope sense suitable wear (use) of the helmet, wherein:
 - i. unsuitable use of the helmet is allowed when the driving speed is lower than the pre-set threshold value, which is preferably 5 km/h,
 - ii. suitable use of the helmet allows ordinary driving (operation) of the vehicle,
 - iii. unsuitable wear of the helmet at speeds higher than the pre-set threshold value, which is preferably 5 km/h, triggers turning off of the vehicle, so that the vehicle module connected to the electronics that control operation of the vehicle, interrupts the circuit of the drive system; or
 - iv. unsuitable wear of the helmet at speeds higher than the pre-set threshold value, which is preferably 5 km/h, triggers limitation of the driving speed, so that the micro-

controller (microprocessor) of the vehicle,
which reads the position of the speed han-
dle and with regards to the read position, a
suitable power is given to the electromotor
in order to limit the driving speed to maxi- 5
mum 10 km/h, preferably maximally 5 km/h.

11. The process according to the preceding claim, **char-**
acterized in that the vehicle is an electric bicycle, a 10
scooter, a motorized bicycle, a motor, a tri-cycle, a
quad (ATV) or a similar vehicle driven by a drive sys-
tem such as an internal combustion engine, electric
drive and other possible drives.

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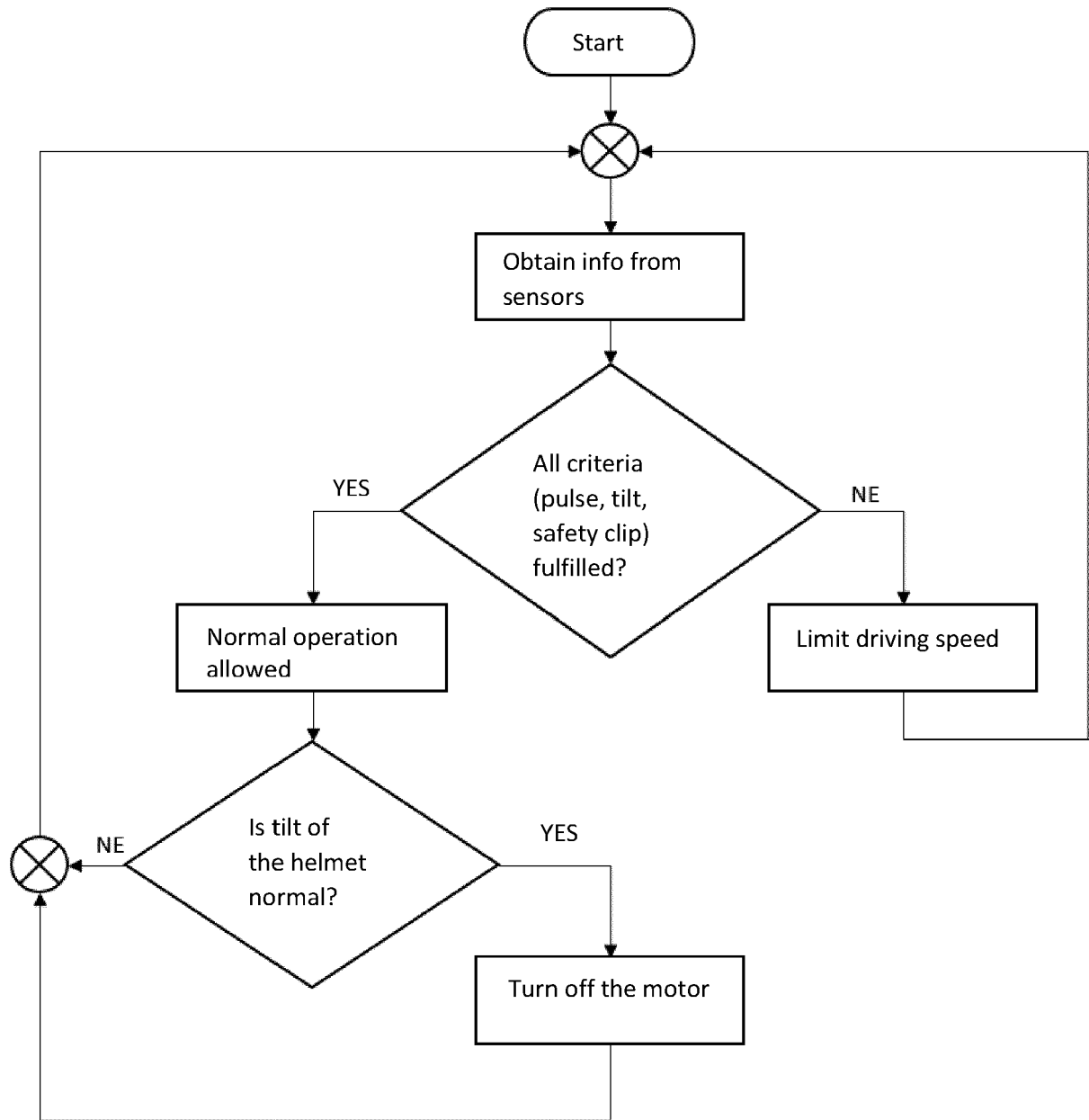


Figure 1

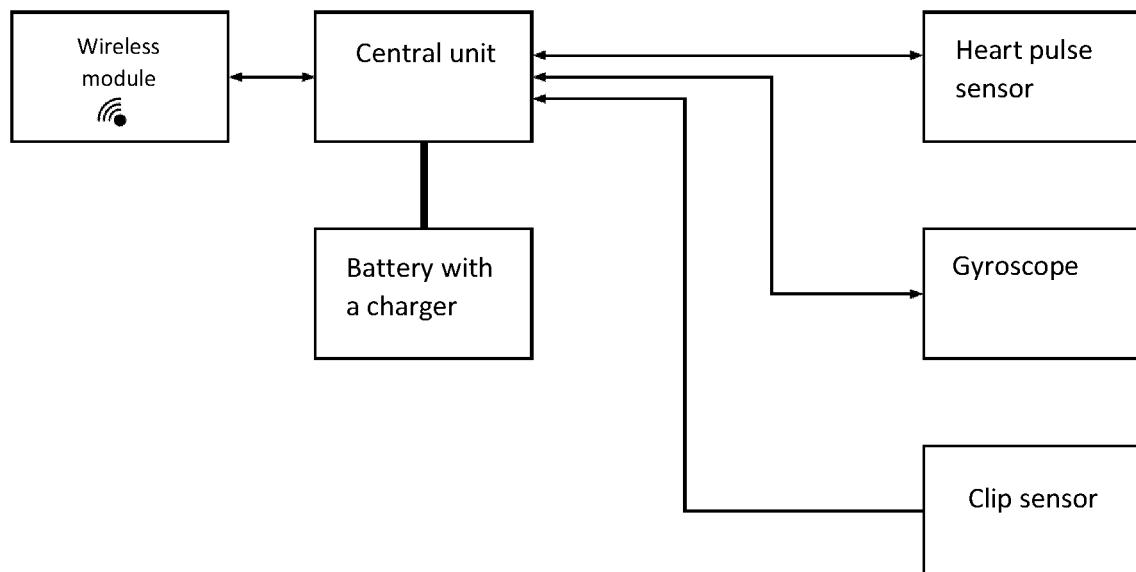


Figure 2

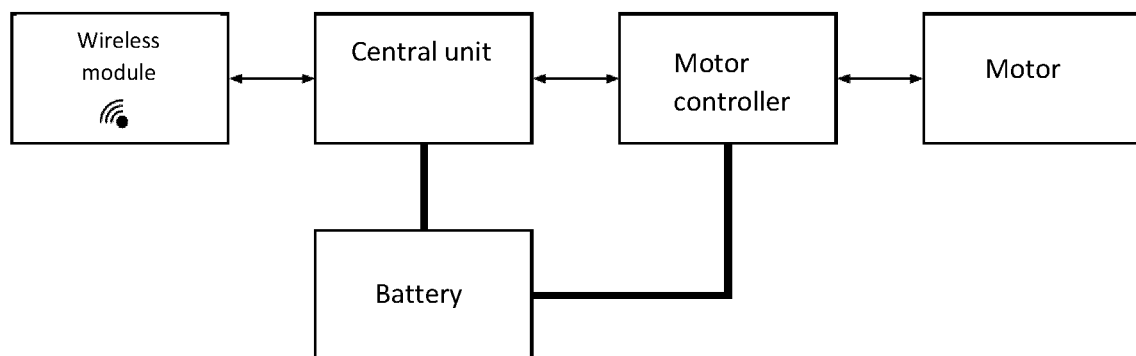


Figure 3



EUROPEAN SEARCH REPORT

Application Number

EP 21 18 9536

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EPO FORM 1503 03.82 (P04C01)

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
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A,D	CN 110 179 195 A (UNIV HUAIYIN NORMAL) 30 August 2019 (2019-08-30) * abstract * -----	1-11	
A	CN 203 996 579 U (HUAIYIN TEACHER COLLEGE) 10 December 2014 (2014-12-10) * abstract * -----	1-11	
			TECHNICAL FIELDS SEARCHED (IPC)
			A42B
The present search report has been drawn up for all claims			
Place of search The Hague		Date of completion of the search 17 December 2021	Examiner D'Souza, Jennifer
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**ANNEX TO THE EUROPEAN SEARCH REPORT
ON EUROPEAN PATENT APPLICATION NO.**

EP 21 18 9536

5 This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report.
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17-12-2021

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
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KR 20180137864 A	28-12-2018	NONE	
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REFERENCES CITED IN THE DESCRIPTION

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