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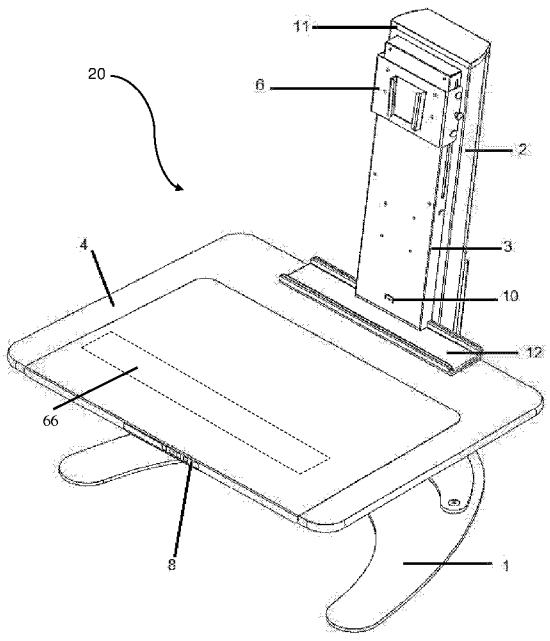

Fig. 1

(57) Abstract: A workstation apparatus for use on a flat surface, the workstation apparatus comprising: a base configured to be disposed on a support surface which is elevated from a floor surface; a fixed pillar attached to the base; a movable pillar movably attached to the fixed pillar; a work surface attached to the movable pillar; and a displacement mechanism configured to move the movable pillar between a lowered position and a raised position, a switch to control the displacement mechanism; at least one proximity sensor configured to detect an object and measure an object distance; and a control unit communicably coupled to the proximity sensor, configured to: determine a presence or absence of a user if a presence of the object and object motion are determined; and record a time stamp information and a position of the work surface; the workstation apparatus allowing a user to convert any elevated support surface like a desk to a sit-stand desk.

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A Movable Work Surface Apparatus

Field of Invention

The invention relates to an apparatus with a movable work surface that allows a user to sit or stand while performing work on the work surface. The apparatus further includes features to track and remind the user of the amount of time spent standing or sitting.

Background

The modern work environment leads people to sit for long periods without much physical activity. According to increasing evidence, this leads to negative health and productivity outcomes. Periodic standing improves the metabolism, blood circulation and sugar levels of a person. Periodic standing places less stress on the spine and encourages a person to adopt a better posture.

Currently, users can purchase a table wherein the height of the table legs can be varied such that the work surface is adjustable, but this requires removing the existing office setup and integrating a new piece of furniture. Conventional moveable monitor stands require an additional clamp to support the frame, which is not practicable on some desks which have perimeter walls or are placed against a wall or window. Aesthetically, this is not pleasing either and some tables may not be suitable for use with a clamp (due to potential markings left on the table surface as a result of the clamp). Hence, existing sit-stand work stations are not suitable for use with existing office furniture and are not a cost effective replacement in many offices or homes.

The apparatus described herein allows a user to convert almost any conventional table to a sit-stand work station without any clamps or a specially designed replacement table.

Summary of Invention

In accordance with a first aspect of the invention, there is provided a workstation apparatus for use on a flat surface, the workstation apparatus comprises: a base configured to be disposed on a support surface which is elevated from a floor; a fixed pillar attached to the base; a movable pillar movably attached to the fixed pillar; a work surface attached to the movable pillar; a displacement mechanism configured to move the movable pillar between a lowered position and a raised position, a switch communicably coupled to the displacement mechanism and configured to control the displacement mechanism; at least one proximity sensor configured to detect an object and measure an object distance; and a control unit communicably coupled to the at least one proximity sensor, wherein the control unit is configured to: based on data acquired by the at least one proximity

sensor, determine a presence or absence of the object and determine a presence or absence of object motion; determine a presence or absence of a user if the presence of the object and the presence of the object motion are determined; and record a time stamp information for each of the presence or absence of the user and record a position of the work surface for each time stamp information.

In one embodiment, the apparatus further comprises a temperature sensor configured to measure ambient temperature and object temperature, wherein the control unit is further configured to: based on data acquired by the temperature sensor, compute a temperature difference in object temperature and ambient temperature; and determine the presence of the user if the presence of object and the presence of object motion are both determined, and if the temperature difference breaches a reference value.

In one embodiment, the data acquired by the proximity sensor includes object distance data, wherein the control unit is further configured to: determine the presence or absence of object motion by analysing object distance data within a predetermined time frame.

In one embodiment, the control unit is further configured to: compute an actual stand duration; if the actual stand duration reaches a target stand duration, generate a sit reminder to prompt the user to switch the work surface to the lowered position.

In one embodiment, the control unit is further configured to: compute an actual sit duration; if the actual sit duration reaches a target sit duration, generate a stand reminder to prompt the user to switch the work surface to the raised position.

In one embodiment, the control unit is further configured to: compute the actual stand or sit duration based on the recorded time stamp information and the recorded position of the work surface.

In one embodiment, the control unit is further configured to: generate the sit or stand reminder by activating a first light feature.

In one embodiment, the workstation apparatus further comprises a motor communicably coupled to the control unit, wherein the control unit is further configured to: generate the sit or stand reminder

by activating the motor to produce a tap motion against the work surface, wherein the tap motion includes a tactile and/or an audible output to the user.

In one embodiment, the sit reminder includes a first combination of tap motion against the work surface and lighting display in the first light feature, and the stand reminder includes a second combination of tap motion against the work surface and lighting display in the first light feature.

In one embodiment, the workstation apparatus further comprises: an interactive panel communicably coupled to the control unit and configured to receive user input of the target stand duration.

In one embodiment, the interactive panel is further configured to display at least one from the group consisting of the actual stand duration, the actual sit duration, the sit reminder, and the stand reminder.

In one embodiment, the interactive panel is further configured to display the sit reminder and the stand reminder, and allow user removal of the sit reminder and the stand reminder.

In one embodiment, the control unit includes a wireless communication component configured to receive user input of the target stand duration from a mobile device.

In one embodiment, the control unit is further configured to: identify the user based on the mobile device.

In one embodiment, the at least one sensor is selected from the group consisting of a proximity sensor, a thermal sensor, and a force sensor.

In one embodiment, the fixed pillar is inclined with respect to the base at an angle of inclination of 91° to 105°.

In one embodiment, the angle of inclination is about 98°.

In one embodiment, the workstation apparatus further comprises a modular mount detachably coupled to the movable pillar.

In one embodiment, the displacement mechanism is an actuator or a gas spring.

In one embodiment, the work surface is configured to be juxtaposed to the base and/or the support surface when the work surface is at the lowered position.

In one embodiment, the workstation apparatus includes a second light feature which is communicably coupled to the control unit and configured to be activated to indicate an availability of the user.

The workstation apparatus allows a user to convert any flat surface, in particular a normal desk, into a sit-stand desk. The apparatus is able to be used by itself without additional supports. This allows for a less cluttered workspace while providing benefits of allowing a user to sit or stand according to the user's choice. The workstation apparatus may be further configured to track and monitor the usage of the apparatus (i.e. the time a user spends in the sitting and standing positions), to set a goal of a standing or sitting time, and to remind the user to change between sitting and standing when or to achieve the goal. This allows the user to adopt a healthier lifestyle while using the apparatus.

Brief Description of the Drawings

The embodiments are described further with the following figures:

Fig. 1 shows a perspective view of an embodiment of the invention in a raised position;

Fig. 2 shows a front view of the embodiment in Fig. 1;

Fig. 3 shows a back view of the embodiment in Fig. 1;

Fig. 4 shows a side cross-sectional view of the embodiment in Fig. 1;

Fig. 5 shows a front view of the embodiment in Fig. 1 in a lowered position;

Fig. 6 shows a back view of the embodiment in Fig. 1 in a lowered position;

Fig. 7 shows a side cross-sectional view of the embodiment in Fig. 1 in a lowered position;

Fig. 8 shows a schematic representation of an embodiment of the invention;

Fig. 9 shows a block diagram for determining the presence of a user; and

Fig. 10 shows a flow chart for setting and meeting a user's target goal.

Detailed Description of Embodiments of the Invention

In the following description, numerous specific details are set forth in order to provide a thorough understanding of various illustrative embodiments of the invention. It will be understood, however,

to one skilled in the art, that embodiments of the invention may be practiced without some or all of these specific details. It is understood that the terminology used herein is for the purpose of describing particular embodiments only, and is not intended to limit the scope of the invention. In the drawings, like reference numerals refer to same or similar functionalities or features throughout the several views.

Fig. 1 shows an apparatus 20 that allows a user to work in a sitting or a standing position. The apparatus includes at least one sensor to detect a user, and a control unit 9 to monitor the usage of the apparatus.

Fig. 2 to 4 show the apparatus 20 in a raised or "UP" position suitable for a user in the standing position. Fig. 5 to 7 show the apparatus 20 in a lowered or "DOWN" position suitable for a user in the sitting position.

The apparatus 20 allows a user to sit or stand to work as desired for health or other reasons. The apparatus 20 comprises a free standing base 1 that allows the base 1 to be supported on any flat surface, for example on a table commonly found in offices or homes, without requiring additional clamps. In particular, the apparatus 20 is suitable to be used on any support surface or platform which is elevated or vertically spaced from a floor or lower enclosing surface of a habitable unit, e.g. room, office. Such habitable unit would typically include a ceiling or upper enclosing surface being arranged vertically opposite to the floor, and one or more side or load-bearing walls supporting the ceiling and floor. Accordingly, the apparatus 20 converts or transforms the elevated support surface or platform to a sit-stand desk.

The free standing base 1 is configured to support the apparatus 20 when it is in the raised and lowered positions. The base 1 is configured to be disposed or installed on a support surface or platform which is elevated from a floor. The base 1 is preferably made of a heavy and durable material, like mild steel of a suitable thickness. The base 1 can be of any shape that is able to support the weight of the apparatus 20. A generally rectangular, circular, V-shaped, or U-shaped base is possible. Alternatively, the fixed pillar 2 could be fitted with a clamp to secure the apparatus 20 to the flat surface, thereby obviating the need for the free standing base 1.

The apparatus 20 has a fixed pillar 2, and a movable pillar 3. The fixed pillar 2 is attached to the base 1. Preferably, the fixed pillar 2 is attached to the base 1 at an angle of inclination (α) to the base as measured when the base 1 is placed on a flat surface. The angle of inclination (α) is shown in Fig. 4

and Fig. 7, and is the angle from the horizontal base to the inclined fixed pillar 2. The angle of inclination could be between 91° and 105°, and should preferably be about 98° as measured from the flat surface.

The fixed pillar 2 has a width (w) or thickness as shown in Fig. 4 and Fig. 7. The width of the fixed pillar 2 could be similar throughout the cross section views in Fig. 4 and Fig. 7 or length of the fixed pillar 2. The width of the fixed pillar 2 could, alternatively, be larger near the bottom of the fixed pillar 2, where the attachment to the base 1 is located, and taper towards the top of the fixed pillar 2 for additional stability.

The movable pillar 3 is mounted on and movable along the fixed pillar 2 by an actuator 5, preferably an electrical actuator 5. More specifically, the movable pillar 3 is mounted on the POM nut of the actuator 5. The POM nut moves along the lengthwise direction of the fixed pillar 2. Preferably, the POM nut is attached to a mounting plate 7 that holds the movable pillar 3 securely. The movable pillar 3 should also preferably be supported with a plurality of roller bearings against the fixed pillar. In a preferred embodiment, four roller bearings were used. Alternatively, the movable pillar 3 could be powered by a gas spring. The fixed pillar 2 and movable pillar 3 may be both made of strong but light material, for example mild steel which is thinner than the base 1, and aluminium.

In an embodiment, the movable pillar 3 could telescope out of the fixed pillar 2. In this embodiment the movable pillar 3 should preferably be made of lightweight materials like aluminium or plastic. To extend the movable pillar 3, the movable pillar 3 is pushed slightly into the fixed pillar 2 to trigger a gas spring that will push the movable pillar 3 upwards into a raised position. Alternatively, a release system (for example a lever or touch system) is connected to the gas spring to activate the gas spring to push the movable pillar upwards.

The movable pillar 3 is attached to a work surface 4. The work surface 4 should preferably be made of a light but strong material that allows a user to type on a keyboard, write on and other activities that will normally be performed on a normal table or support surface. Some suitable materials for the work surface 4 are medium density fibreboard, high density fibreboard, solid wood and some plastic material. In the lowered position, the work surface 4 should be proximal or juxtaposed to the base 1 and/or table (support surface), such that when the apparatus 20 is placed on a normal table (or support surface), the work surface 4 is at a comfortable working level for the user (in other words the work surface 4 is at approximately the same level as the original table or juxtaposed to the

support surface). Preferably, the work surface 4 should contact the base 1. Based on this, the optimal position of the work surface would be at the lower end of the movable pillar 3, preferably proximal to or at the base of the movable pillar 3.

When the work surface 4 is raised by the movable pillar 3, the work surface 4 is supported only by its attachment to the movable pillar 3. Thus, it is crucial that the base 1 is able to support the work surface 4 in the raised position when forces applied on the work surface 4 will be magnified by the lever effect of the work surface 4. This is the main reason why existing similar apparatuses require an additional clamp or support for stability.

A modular mount 6 is detachably coupled to the movable pillar 3. The modular mount 6 can be attached at varying positions along the movable pillar 3 to provide different user height preferences, and is preferably able to swivel and tilt at various angles to accommodate different users. The modular mount 6 can be a single monitor mount, a dual monitor mount, or a surface top mount that can accommodate a laptop. Preferably, the modular mount 6 for the monitor is a Flat Display Mounting Interface also known as VESA Mounting Interface Standard. The type of modular mount 6 depends on the requirement of the user. If the work surface 4 is to be used as a normal writing surface there is no requirement for a mount 6 to be attached. In an office environment where personal computers are prevalent, the mount 6 can be used to attach one or two monitors for the user. The mounting of the two monitors could be via a mount bar for two monitors. Alternatively, the mount 6 can attach an additional surface for a laptop to be placed.

The movable pillar 3 is configured to be driven by the actuator 5 between the lowered and raised positions. The actuator 5 is controlled by a switch 48 preferably located near a user's default position facing the apparatus 20. This allows the user to easily and quickly raise or lower the work surface 4. Preferably, the switch 48 to control the actuator 5 is a "One-touch" button 48 that allows the user to move the surface up or down at a single touch of the button 48. Preferably, the switch 48 is placed near or at a sensor compartment 8. Other user input buttons 48 may be provided for various functions, e.g. "Power On-Off" button to power on or off the apparatus 20, "Up" button to move the work surface 4 up, "Down" button to move the work surface down, and "Preset Height" button to move the work surface 4 to a preset height. Some of these functions may be integrated into one button.

There are several reasons for requiring an angle of inclination. Firstly, the angle of inclination allows a similar distance to be maintained between the user and the movable pillar 3 (including a monitor mounted on the movable pillar 3 as described later) without moving the position of the apparatus 20. This is due to the differences in the body posture when a person sits and stands. This provides a more comfortable user experience when the apparatus 20 is used in different positions. Secondly, the angle of inclination provides a more stable apparatus when the movable pillar 3 is raised to a higher position. This adjusts the centre of gravity of the apparatus and reduces the possibility of the apparatus toppling in the raised position, in particular when a force is applied to the work surface 4. Existing similar apparatuses use an additional clamp or additional support to counter the change in the centre of gravity, and provide the required stability.

The apparatus 20 is preferably fitted with a raised ledge 12 that is attached to the movable pillar 3 or work surface 4. The ledge 12 lends additional stability and can be used to keep personal items like a mobile device, stationery, and similar items.

An optional first light feature 10 is shown near the bottom part of the movable pillar 3. The first light feature can be used to indicate or remind a user of a certain event. For instance, the first light feature 10 can be used to remind the user to stand to meet the target goal or to sit upon reaching the target goal, which will be discussed in detail later. Similarly, the position of the first light feature 10 is not limited to the bottom part of the movable pillar 3, and should ideally be positioned to be visible to the user, and can be of any conventional lighting means as for the second light feature 11. The first light feature 10 could also be placed with the sensor compartment 8.

At the top end of the fixed pillar 2, an optional second light feature 11 is provided. The second light feature 11 could be made of any conventional lighting means, for example having at least one LED light, or fluorescent light. The second light feature 11 should preferably be coloured, for example blue, orange, green, or red, by having a coloured LED light or a coloured filter, to allow the user to indicate the status of the user to other people. For example, a green light could indicate that the user is available while a red light could indicate that the user is not available, e.g. busy and does not wish to be disturbed at that point in time. A single light could also serve the same or other purposes as required. The second light feature 11 could alternatively be placed along the sides of the movable 3 or fixed pillar 2 as a stripe. The position of the second light feature 11 is not fixed, and could be in any position which is visible by people around the apparatus. The second light feature 11 should preferably be controllable by a user input button.

A sensor compartment 8 is located on or near the work surface 4 for convenient access and to enable detection of a user. The apparatus 20 comprises at least one sensor that detects the presence of a user. Preferably, the position of the sensor is directed towards the front of the apparatus 20 where the user is likely to be sitting or standing. Some examples of a possible sensor are a force sensor, a proximity sensor 44 (motion detector), and a thermal sensor 46 (temperature sensor). The proximity sensor 44 can be an infra-red (IR) sensor. The thermal sensor 46 can be a pyrometer like a thermal infra-red sensor, a high sensitivity thermal laser sensor, or a high sensitivity thermal sensor with multiple cells that can assign temperatures to different cells and therefore monitor heat emitted from a stationary human body.

The force sensor can possibly be placed between the attachment of the work surface 4 and the movable pillar 3, preferably when the attachment is at the base of the movable pillar 3. Thus, when there are any changes in the force exerted on the work surface 4, for example by a person typing or resting his hands on the work surface 4, the force sensor will detect this. There could be situations when the user is present in front of the apparatus 20 but not touching the work surface 4, hence the force sensor should preferably be used in unison with another sensor.

A temperature (thermal) sensor 46 measures the ambient temperature and the temperature of an object in front of the apparatus 20 to detect the presence of a user at the apparatus 20. Another possible sensor is a proximity sensor 44 which detects whether an object is present within the range of the proximity sensor 44. Two or more of the sensors can work in combination to provide for more accurate determination of a user's presence.

The work surface 4 may include a hollow or enclosure for housing a motor 66 or actuator which is configured to produce a tap motion against the work surface 4. As illustrated in Figs 1, 4 and 7, the motor 66 may be housed near the sensor compartment 8 such that the tap motion may be produced at an area where the user is located or expected to place his forearms, e.g. within one-quarter width or area of the work surface 4, which is remote from the fixed pillar 2. This placement would enhance user detection of a tactile and/or an auditory output produced by the tap motion.

A control unit 9 is provided to receive data from the sensor(s) and actuator 5. The control unit 9 may contain a printed circuit board and at least one processor 52 to process the data from the various

connected components as shown in Fig. 8. The control unit 9 may further comprise at least one communication bus interface, e.g. USB 2.0, USB 3.0, USB 3.1 and/or its future version or equivalent, for enabling communication among the connected components. Multiple USB ports may be provided, including a powered port configured to charge a user's electrical device, e.g. user's mobile device, mini-fan, or mini-clock. The control unit 9 could also be housed in the fixed pillar 2.

Preferably, two microprocessors 42, 52 are provided to retain data integrity from the sensor(s). The sensor compartment 8 may further comprise a front panel board 40 that has a front panel microprocessor 42 to receive data from the sensor(s) and at least one user input button or switch 48 before transmitting the data to the main microprocessor 52 as in Fig. 8. The preferred sensors could be a proximity sensor 44 and a thermal sensor 46. The front panel microprocessor 42 and main microprocessor 52 are coupled in digital communication via data connectors known in the art, for example LVTTL Serial UART 70.

The control unit 9 further comprises a main controller board 50 with a main microprocessor 52 which is configured to receive and send data to the various components. The control unit 9 is preferably provided with a wireless communication component 54 like Bluetooth, Wi-Fi, cellular module, or radio to allow wireless communication with a mobile device held by a user. For instance, the user mobile device could be a cellular phone, a tablet, a personal digital assistant, a smartwatch, and similar apparatus or alternatively a radio frequency identification (RFID) tag, or iBeacon. The wireless communication component 54 could also serve as a part of a larger network of connected work stations in the same office. The wireless communication component 54 could also synchronise with a cloud server to allow the apparatus 20 to communicate with the user's mobile device or with internet based applications.

The user mobile device could have several purposes, mainly to allow the user to interact with the apparatus 20. In a preferred embodiment, the user mobile device is provided with an application program to allow the user to set a target goal, be reminded to sit or stand, view the usage record of the apparatus 20 in numerical or graphical format, and control the apparatus remotely. The user would also be able to set future target goals and progressive target goals (i.e. stand 10 minutes within first week, stand 20 minutes within second week, and so forth). The application could preferably allow the user to view the time events regarding the usage of the apparatus 20. The application could be run on the user mobile device and/or is web based and accessible through a

website or cloud server. The user mobile device, apparatus 20 and web based application could all be able to synchronise to provide the user with a seamless experience.

The application program may include a learning algorithm configured to learn about user's usage pattern and suggest goals or suitable schedules for sitting and/or standing based on what the application program has learnt. The application program could also be configured to interact with mobile or web applications that contain contextual data regarding the user's workday. For example, the application could interact with the user's calendar application. If the application finds an activity, like a meeting that suggests the user may have a prolonged period of sitting time, the application could suggest more standing time to the user when using the apparatus 20, either through the application or the apparatus 20 directly.

Another embodiment would allow the user mobile device to serve as a wireless identification tag to activate the apparatus 20, preferably identifying the unique individual user who is present, to allow the apparatus 20 to be utilised by multiple users without the need to manually change the user identity each time. This is useful in offices with a hot-desking policy, in shared offices, or at homes where different family members share the same apparatus 20.

The main processor 52 controls activation of the first and second light features 10, 11 to light up depending on the various requirements. The user could activate the second light feature 11 by a button to indicate the user's status via the main processor 52. The main processor 52 is connected to a motor controller 56. Thus, when a user activates the user input button 48, an appropriate current signal is sent to the actuator 5 to raise or lower the movable pillar 3. There should preferably be a current sensor 58 that detects the current from the motor controller 56 to the actuator 5 and sends the reading back to the main microprocessor 52. The current sensor serves as a safeguard to inactivate the actuator when an overcurrent is detected, which may occur when the work surface 4 is obstructed when it is lower or raised, for instance, if a person is blocking the downward movement of the work surface 4 or if an obstacle such as a cup is left under the work surface 4.

The main controller board 50 further comprises a memory apparatus 60 which is configured to allow the data from the various components to be stored and a real time clock 62 to provide a time stamp to allow for the tracking of the usage of the apparatus. The memory 60 could be a hard disk drive, an Electrically Erasable Programmable Read-Only Memory (EEPROM), a flash memory and similar storage devices as known in the art.

Fig. 9 shows how a user's presence can be detected by one or more sensors, preferably with at least two sensors. A temperature sensor 46 measures the ambient temperature. The ambient temperature may be measured as an average of values over a period of time to account for minor temperature variances. In block 221, the temperature sensor 46 further measures the temperature of an object in front of the apparatus 20, for example the user, to provide the object temperature. In block 222, the control unit 9 ascertains or computes a temperature difference between the object and ambient temperature.

In block 223, the temperature difference is subsequently used to determine if the user is present at the apparatus 20. For instance with an ambient room temperature of 25 °C and a body surface temperature of 30 °C (typically, the human body surface temperature that is measured by the sensor is in the high twenties to low thirties), an absolute temperature difference of greater than 4 °C will indicate that a user is present. Thus in block 224, when the temperature difference breaches, for example, greater than or equal to, a reference value of, for example 4 °C, a "yes" response will be generated. If temperature difference is less than the reference value, a "no" signal in block 225 is generated. By measuring the ambient temperature, the reference value can be determined accordingly by the control unit 9 to account for any changes in ambient temperature.

Another possible sensor is a proximity sensor 44 which detects if an object is present within the range of the proximity sensor 44 and/or object distance. In block 201, if no object is within the range of the proximity sensor, the corresponding data signal is sent. In block 202, if an object is detected within the range of the proximity sensor 44, the method proceeds to block 203 wherein the proximity sensor 44 further measures the distance between the apparatus 20 and the object.

In block 204, the distance readings in block 203 are used or analysed to determine if the object is moving more than a predetermined number of times within a certain time frame (for example Y counts in 10 seconds). This is to determine if the object detected is a human user or an inanimate object like a chair. This also seeks to eliminate the scenario whereby a person passes by or momentarily stops by the apparatus 20 in the range of the proximity sensor 44. Thus, the proximity sensor 44 detects objects and measures object distance while the control unit 9 determines whether an object is "moving" (in block 205) or "not moving" (in block 206) based on the measured object distance readings.

In block 231, after receiving the data signals from any of blocks 201, 205, 206, 224, and 225, the apparatus 20 (e.g. control unit 9) determines whether the user is present based on the conditions in block 232. Table 1 shows the possible conditions that the apparatus 20 (e.g. control unit 9) may use to determine whether a user is present or absent as shown in block 232.

Table 1

User Absent Conditions	User Present Conditions
1. Object out of range of proximity sensor (block 201). 2. Object within range of proximity sensor 44 but not moving (block 206). 3. Temperature difference is less than a reference value (block 225).	1. All other conditions (block 205, 224), except those under the absent conditions.

In block 231, based on the predetermined conditions in block 232, a user is determined as either present (see block 233) or absent (see block 234). This determination (e.g. presence or absence of user) is subsequently time-stamped based on the real time clock 62 to record the time the user is present at the apparatus 20. Time stamp information and corresponding position of work surface for each time stamp information are stored or recorded in the memory 60 of the control unit 9.

The data from two sensors or two sensor types will provide a better indication of the presence of the user, and reduce errors from a single sensor. Preferably, in order to detect a user as being present, two sensors are required to determine if a user is present. It has been found that certain materials used in office chairs or clothing (for example a sweater or jacket) left on the chair retains the thermal energy even after a user has left, and produces a temperature measurement similar to that of a human body surface. This could result in an erroneous reading from the temperature sensor 46. The absorbed thermal energy will dissipate in a short period of time to return to the ambient temperature; nonetheless, this affects the accurate measurement of the usage of the apparatus 20.Therefore, an additional sensor of a different type would be preferable.

While the above description and Fig. 9 illustrate the use of two sensor types, it is to be appreciated that one sensor type may be used in certain embodiments of the invention. For example, only proximity sensor is used while temperature sensor is omitted. In this example, the flow sequence of Fig. 9 is modified accordingly to omit temperature sensor.

The proximity sensor 44 could be sufficiently sensitive to detect distance changes in a user's body, which resulted from breathing, for example, detecting the movement of the chest when breathing in and out. The problem with such high sensitivity is that the movement of a piece of clothing, left on a chair in front of the apparatus 20, due to air circulation in the vicinity of the apparatus 20 or chair will also be detected. This leads to a false positive result of a user being present. By combining data from two or more sensors or types of sensors, instances of false positives or false negatives are reduced. This provides a more accurate determination of the user's presence. The sensors and algorithm can run at a sample rate of 1 second preferably to allow optimal detection of the user.

In addition to detecting if a user is present, the apparatus 20 (e.g. control unit 9) is configured to track and monitor the usage of the apparatus 20 in the different modes. The apparatus 20 (e.g. control unit 9) determines that a user is present, by using the sensors as described above or by the user activating the apparatus 20. Preferably the sensor detection is configured to take precedence since the sensors do not rely on an additional device (user mobile device). The apparatus 20 (e.g. control unit 9) subsequently records the time the user spends standing or sitting in front of the apparatus 20.

Fig. 10 shows an example of a method 300 of how the apparatus 20 tracks and monitors the user's usage pattern and rate. The apparatus 20 (e.g. control unit 9) is configured to preferably send reminders to the user to sit or stand as per the goal set by the user via the first light feature 10.

In block 301, the user sets a target goal of a standing time duration (t_2). In block 302 a sitting time duration (t_3) will be determined automatically by the microprocessor 42, 52 based on t_2. Alternatively, the sitting time duration could be provided by the user. In block 303, the apparatus 20 is in a standby mode awaiting input from the sensors.

In block 304, it is first determined if a user is present for a certain amount of time t_1, for example 60 seconds, indicating that the user is working at the apparatus 20 and is not a transient user, and thereby proceeding to block 310.

In block 310, the control unit 9 (e.g. processor 52) determines if the work surface 4 is in the raised ("UP") or lowered ("DOWN") position. In block 311, the apparatus 20 is in the "UP" position, the Stand Duration count (e.g. actual stand duration) is started and computed by the control unit 9, and the Sit Duration count (e.g. actual sit duration) is stopped. In block 312, if a target goal of t_2 is

reached, a sit reminder in block 313 is issued or generated to prompt the user to switch the work surface to the lowered position. If the target goal is not reached, the method loops back to block 304 to determine if the user is still present. In block 305, the count (if any) stops if the user is not present for more than t_1 in block 304.

In block 316, when the desk is in the "DOWN" position, the Sit Duration count (e.g. actual sit duration) is started and computed by the control unit 9, and the Stand Duration count (e.g. actual stand duration) is stopped. In block 317, if a target goal of t_3 has been reached, a stand reminder in block 318 is issued or generated to prompt the user to switch the work surface to the raised position. If the target goal is not reached, the method loops back to block 304 to determine if the user is still present. In block 305, the count (if any) is stopped if the user is not present for more than t_1 in block 304.

In block 304 if the user is not present originally, the method proceeds to block 305. If the user did not set a target goal in block 301, t_2 and t_3 have no value and the method 300 loops back to block 304 to continuously record the standing or sitting time of the user. A default value for the target goals could also be provided without user input.

In an illustrative example, user A sets a target goal of standing 50% of the usage time and sets a standing time of 30 minutes before switching. The system will determine that the sitting time is therefore also 50% or 30 minutes. If user A starts using the apparatus 20 in the standing position, after 30 mins, the apparatus 20 determines that user A has reached his target goal of 50% for a 1 hour span and issue a "Sit" reminder in the form of the first light feature 10 lighting up or blinking to attract the user's attention. User A lowers the work surface and takes on a sitting position. After another 30 minutes, the apparatus 20 again alerts User A to "Stand" via the first light feature 10. The user can choose to ignore the alert to "Sit" or "Stand", or remove the alert by pressing at least one user input button. The apparatus 20 records accordingly the duration User A has spent in the different modes and provides the appropriate reminder so that User A meets or exceeds his target goal of standing 50% of the usage time.

In another example, User B has set his target goal to be 10 minutes for every hour of usage. User B may choose to start in the sitting position, the apparatus records User B has spent 50 minutes sitting and send a "Stand" reminder via the first light feature 10 to stand for 10 minutes to meet User B's target goal.

The "Sit" or "Stand" duration recorded need not be continuous or take place within a single period. For instance, User B could choose to stand for 5 minutes at the start before sitting for 50 minutes and subsequently standing for another 5 minutes, or in any other possible combinations. The apparatus 20 allows the user to sit and stand as per their choice while allowing the apparatus 20 to record and track their usage. The detection of the user's presence in front of the apparatus 20 prevents recording of the time when the user is not present. Thus, the user can leave the apparatus 20 without having to activate or reactivate the apparatus 20 each time. It should be understood that the duration could be adjusted by the user to allow different sit-stand regimes.

In an embodiment, the apparatus 20 further comprises a display panel, e.g. interactive panel, that allows the user to interact with the apparatus 20 – for instance to set a target goal, view the usage record of the apparatus in numerical or graphical format, serve as a reminder to the user to sit or stand, choose the user identity, and other functions. The display panel could also allow the user to acknowledge and remove the Sit/Stand alert or reminder.

In an embodiment, the sit/stand reminder may be provided as a kinetic motion. The kinetic motion may be provided by a motor or actuator arranged within or under the work surface. For example, the work surface may include a hollow or enclosure for housing the motor; the motor may be arranged at an area/edge near to an expected user position or near the sensor(s). The motor or actuator is configured to produce a tap motion against the work surface. Tap motion refers to one or more strikes against the work surface, which produce a tactile output or an audible output or both to attract user attention e.g. user's forearms resting on the work surface can feel the tap motion and/or user and hear the tap motion. Accordingly, the sit/stand reminder may be provided by producing one or a series of tactile and/or audible tap motion against the work surface. The sit and stand reminders may be differentiated by different tap motion rhythms.

In an embodiment, the sit/stand reminder may be provided as a combination of kinetic motion and lighting display. The sit and stand reminders may be differentiated by pre-setting a first combination or rhythm of tap motion against the work surface and lighting display in the light feature for the sit reminder, and pre-setting a second combination or rhythm of tap motion against the work surface and lighting display in the light feature for the stand reminder. Each lighting display e.g. flash, in the light feature may be synchronised with a tap from the motor, which is customised to the reminder type being generated. For example, the sit reminder may include one tap accompanied

simultaneously by one flash of light. If the target sit goal is reached, a stand reminder is issued or generated to prompt the user to switch the workstation to the raised position. In this situation, the stand reminder may include two taps accompanied simultaneously by two flashes of light. Other combinations or rhythms of tap motion and lighting display are possible and may be customised by the user. In any case, the user may choose to dismiss or to comply with the reminder by pressing on the relevant buttons in the display panel, e.g. interactive panel.

In an embodiment, the tap/light feature may be used to notify the user of other requirements. For example, if the user achieves his/her stand goal for the day, this may be communicated to the user by a predetermined combination of tap motion and lighting display, e.g. synchronisation of celebratory taps and light feature.

Fig. 8 shows a motor 66 or actuator electrically coupled to the control unit 9 (main processor 52) but it is to be appreciated that the motor or actuator for generating tap motion against the work surface may be suitably coupled control unit 9 in other ways known to persons skilled in the art.

Many existing standing desks do not remind their users to sit or stand, or do so ineffectively through methods that are not easily observed when the user is busy with his/her work. Accordingly, a combination of kinetic motion (within the work surface) and light feature (at/near the sensor compartment or movable pillar or other suitable location) ensure the user is suitably alerted when it is time for the user to sit/stand. A synchronised combination of kinetic tapping-like motion and lighting display would ensure that the user is made sufficiently aware of the reminder via tactile and/or auditory outputs, without possibly endangering or annoying the user (who might be engrossed in his/her work) by sudden displacement movements (e.g. in the case of a desk displacement system) or a non-subtle vibration mechanism. In addition, the synchronisation of the kinetic motion produced by the motor and lighting display produced by the lighting feature provides various combinations which can be customised to the reminder type being generated and user preference.

Whilst there has been described in the foregoing description preferred embodiments of the present invention, it will be understood by those skilled in the field concerned that many variations or modifications in details of design or construction may be made without departing from the present invention.

Claims

1. A workstation apparatus comprises:

a base configured to be disposed on a support surface which is elevated from a floor;

a fixed pillar attached to the base;

a movable pillar movably attached to the fixed pillar;

a work surface attached to the movable pillar;

a displacement mechanism configured to move the movable pillar between a lowered position and a raised position;

a switch communicably coupled to the displacement mechanism and configured to control the displacement mechanism;

at least one proximity sensor configured to detect an object and measure an object distance; and

a control unit communicably coupled to the at least one proximity sensor, wherein the control unit is configured to:

based on data acquired by the at least one proximity sensor, determine a presence or absence of the object and determine a presence or absence of object motion;

determine a presence or absence of a user if the presence of the object and the presence of the object motion are determined; and

record a time stamp information for each of the presence or absence of the user and record a position of the work surface for each time stamp information.

2. The workstation apparatus according to claim 1, further comprises a temperature sensor configured to measure ambient temperature and object temperature, wherein the control unit is further configured to:

based on data acquired by the temperature sensor, compute a temperature difference in object temperature and ambient temperature; and

determine the presence of the user if the presence of object and the presence of object motion are both determined, and if the temperature difference breaches a reference value.

3. The workstation apparatus according to any one of claims 1 to 2, wherein the data acquired by the proximity sensor includes object distance data, wherein the control unit is further configured to:

determine the presence or absence of object motion by analysing object distance data within a predetermined time frame.

4. The workstation apparatus according to any preceding claim, wherein the control unit is further configured to:

compute an actual stand duration; and

if the actual stand duration reaches a target stand duration, generate a sit reminder to prompt the user to switch the work surface to the lowered position.

5. The workstation apparatus according to claim 4, wherein the control unit is further configured to:

compute an actual sit duration; and

if the actual sit duration reaches a target sit duration, generate a stand reminder to prompt the user to switch the work surface to the raised position.

6. The workstation apparatus according to claim 5, wherein the control unit is further configured to:

compute the actual stand or sit duration based on the recorded time stamp information and the recorded position of the work surface.

7. The workstation apparatus according to any one of claims 4 to 6, wherein the control unit is further configured to:

generate the sit or stand reminder by activating a first light feature.

8. The workstation apparatus according to any one of claims 4 to 7, further comprising a motor communicably coupled to the control unit, wherein the control unit is further configured to:

generate the sit or stand reminder by activating the motor to produce a tap motion against the work surface, wherein the tap motion includes a tactile and/or an audible output to the user.

9. The workstation apparatus according to claim 8, wherein the sit reminder includes a first combination of tap motion against the work surface and lighting display in the first light feature, and the stand reminder includes a second combination of tap motion against the work surface and lighting display in the first light feature.

10. The workstation apparatus according to any one of claims 4 to 7, further comprising:

an interactive panel communicably coupled to the control unit and configured to receive user input of the target stand duration.

11. The workstation apparatus according to claim 10, wherein the interactive panel is further configured to display at least one from the group consisting of the actual stand duration, the actual sit duration, the sit reminder, and the stand reminder.

12. The workstation apparatus according to claim 10, wherein the interactive panel is further configured to display the sit reminder and the stand reminder, and allow user removal of the sit reminder and the stand reminder.

13. The workstation apparatus according to any one of claims 4 to 12, wherein the control unit includes a wireless communication component configured to receive user input of the target stand duration from a mobile device.

14. The workstation apparatus according to claim 13, wherein the control unit is further configured to: identify the user based on the mobile device.

15. The workstation apparatus according to any preceding claim, further comprising a force sensor.

16. The workstation apparatus according to any preceding claim, wherein the fixed pillar is inclined with respect to the base at an angle of inclination of 91° to 105°.

17. The workstation apparatus according to claim 16, wherein the angle of inclination is about 98°.

18. The workstation apparatus according to any preceding claim, further comprising a modular mount detachably coupled to the movable pillar.

19. The workstation apparatus according to any preceding claim, wherein the displacement mechanism is an actuator or a gas spring.

20. The workstation apparatus according to any preceding claim, wherein the work surface is configured to be juxtaposed to the base and/or the support surface when the work surface is at the lowered position.

21. The workstation apparatus according to any preceding claim, further comprising a second light feature which is communicably coupled to the control unit and configured to be activated to indicate an availability of the user.

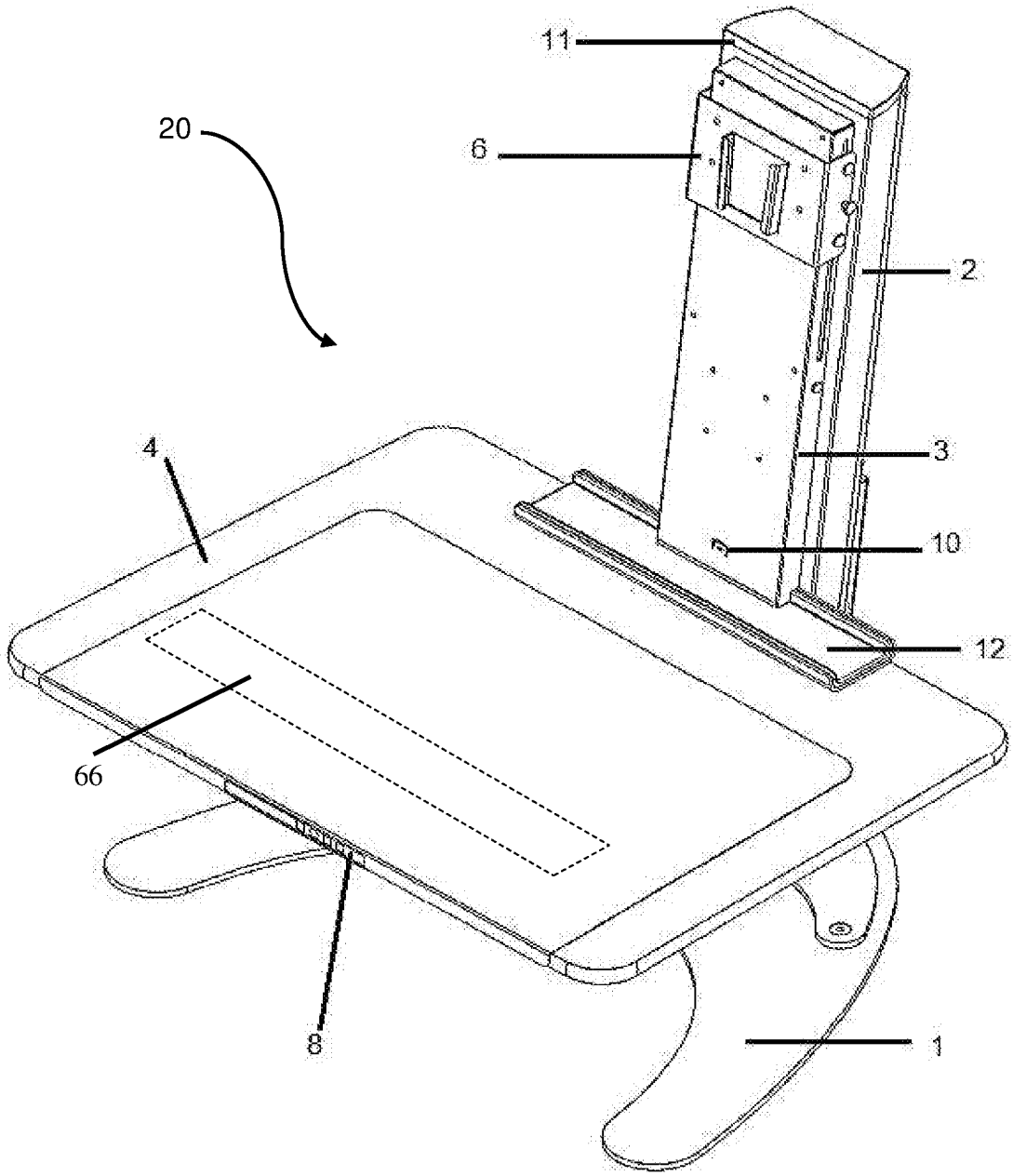

Fig. 1

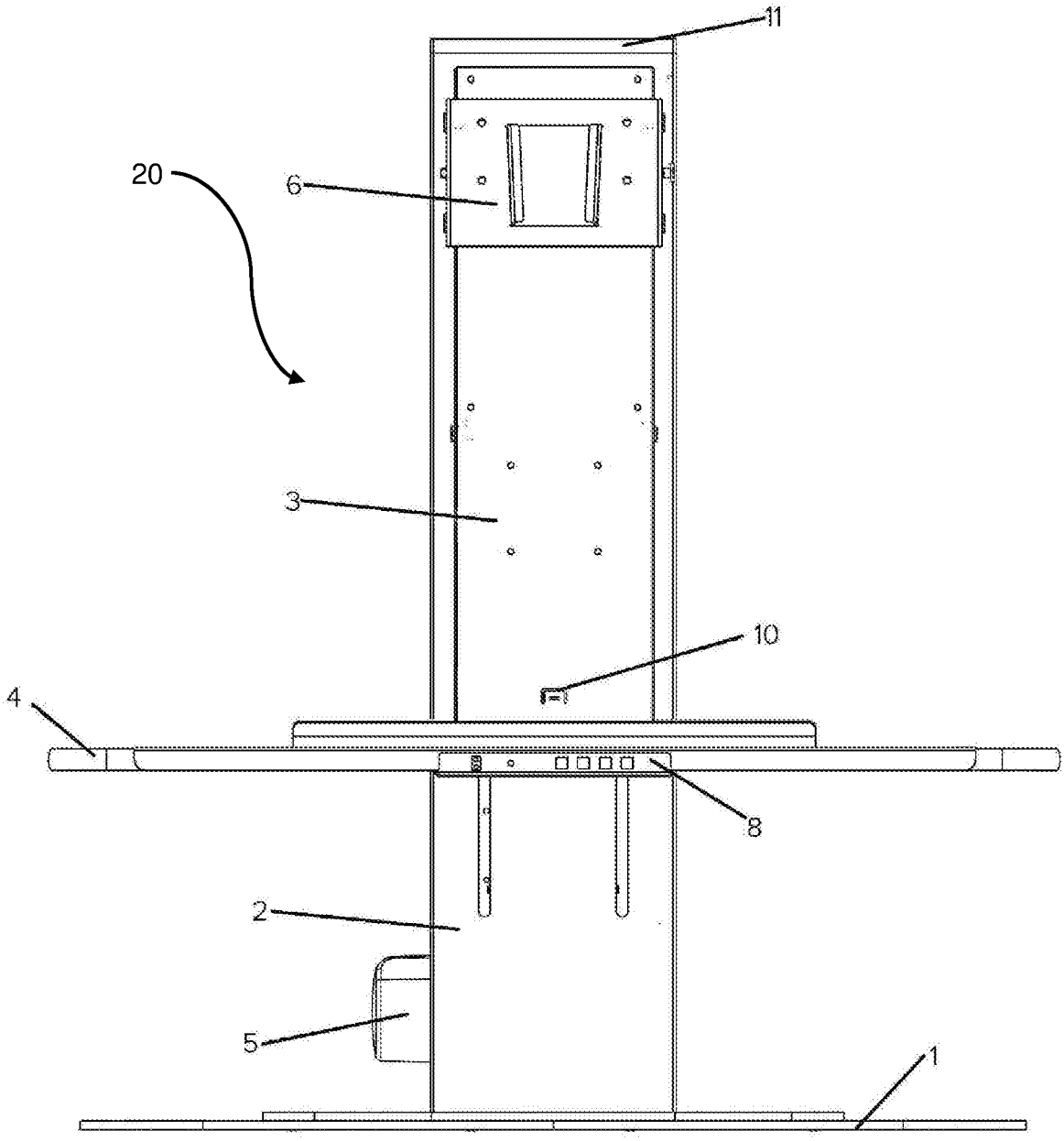

Fig. 2

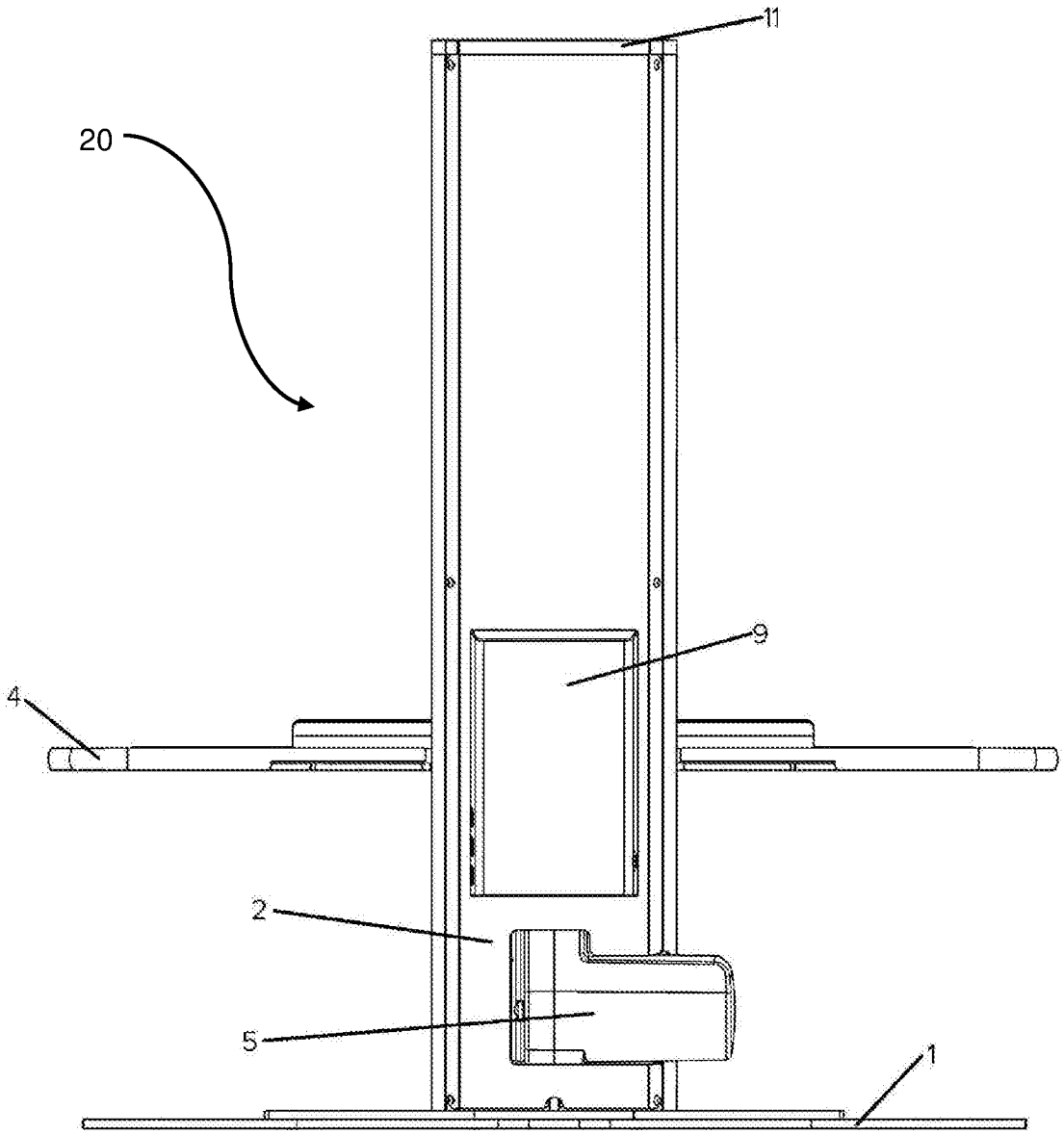

Fig. 3

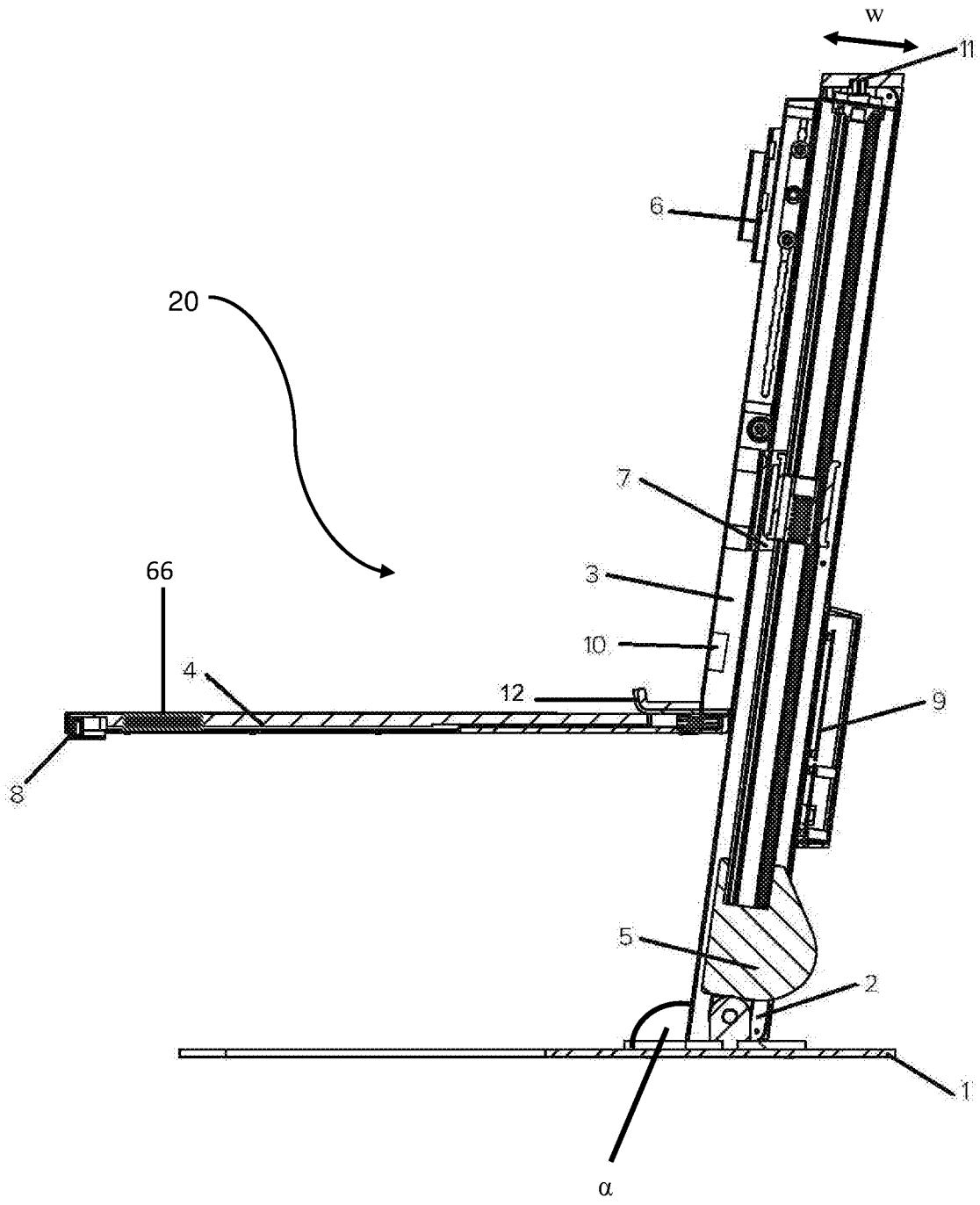

Fig. 4

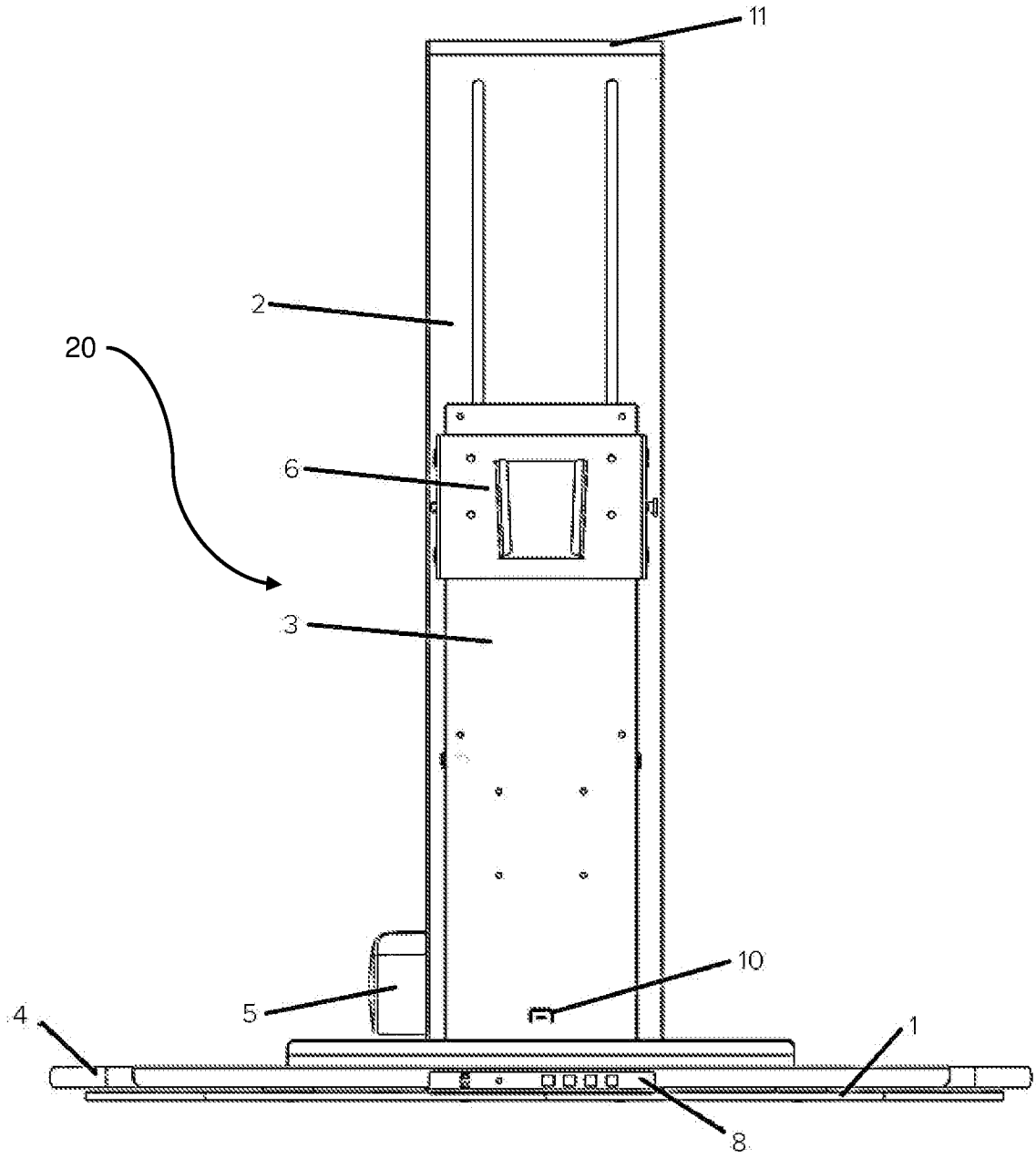

Fig. 5

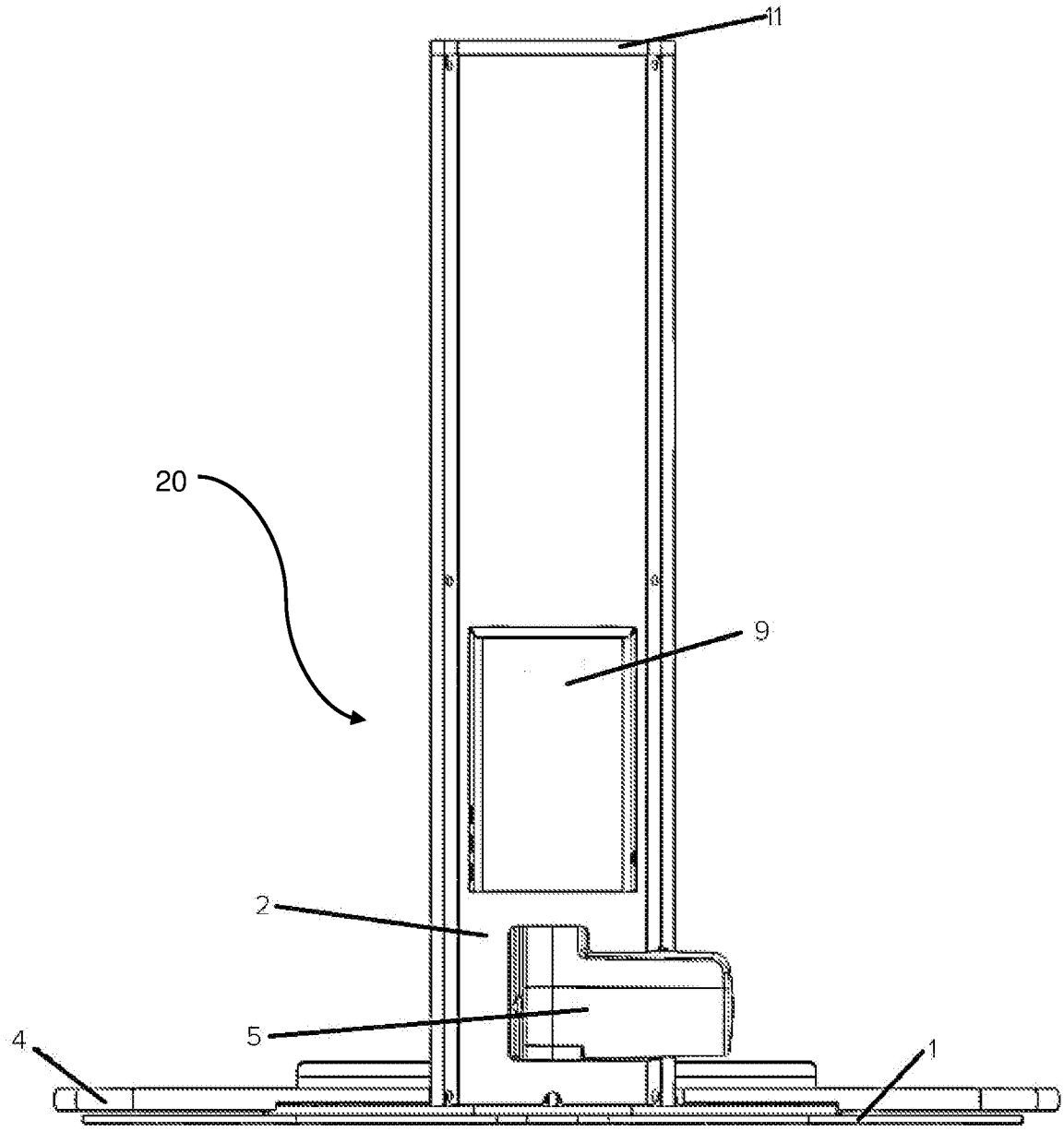

Fig. 6

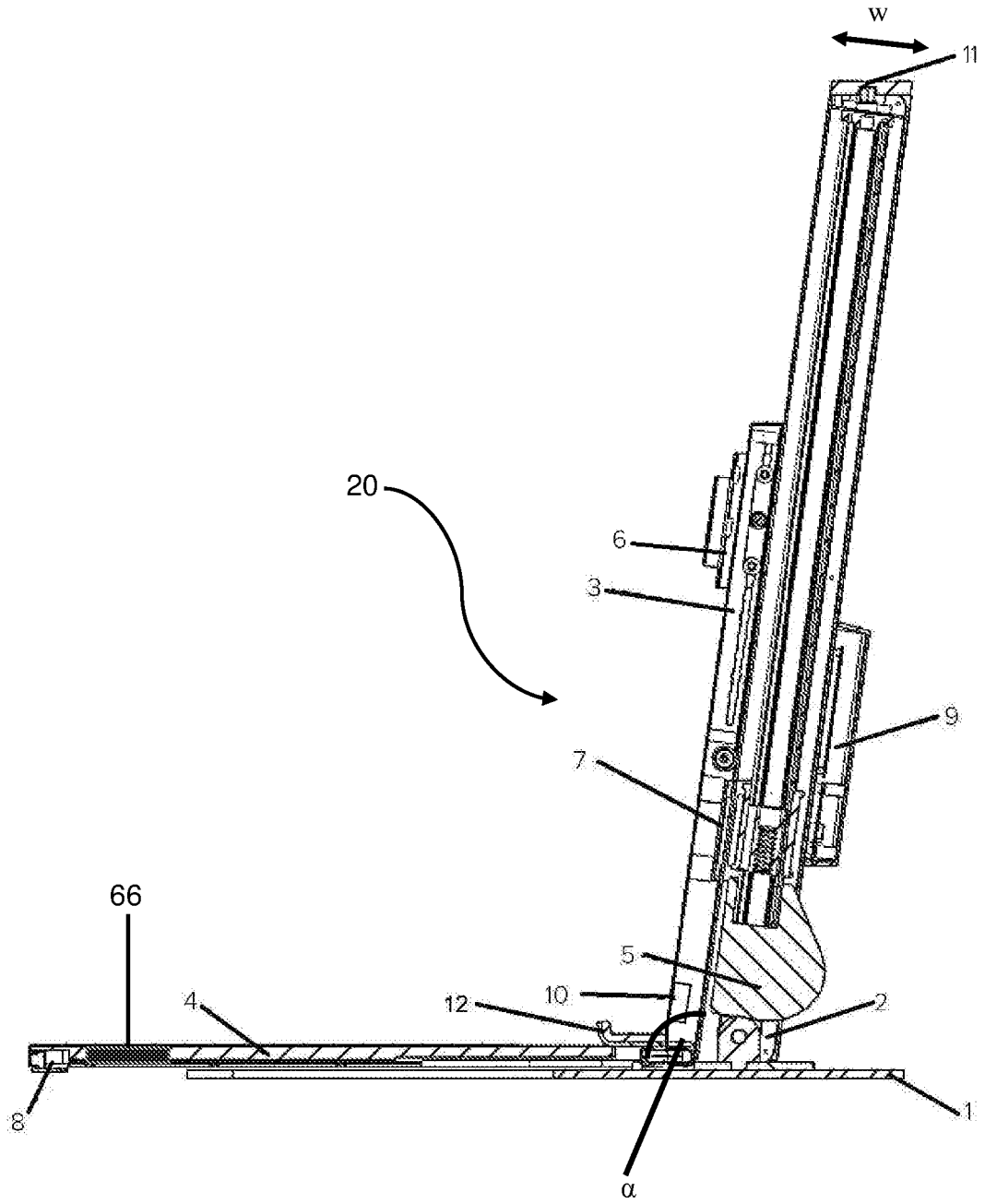

Fig. 7

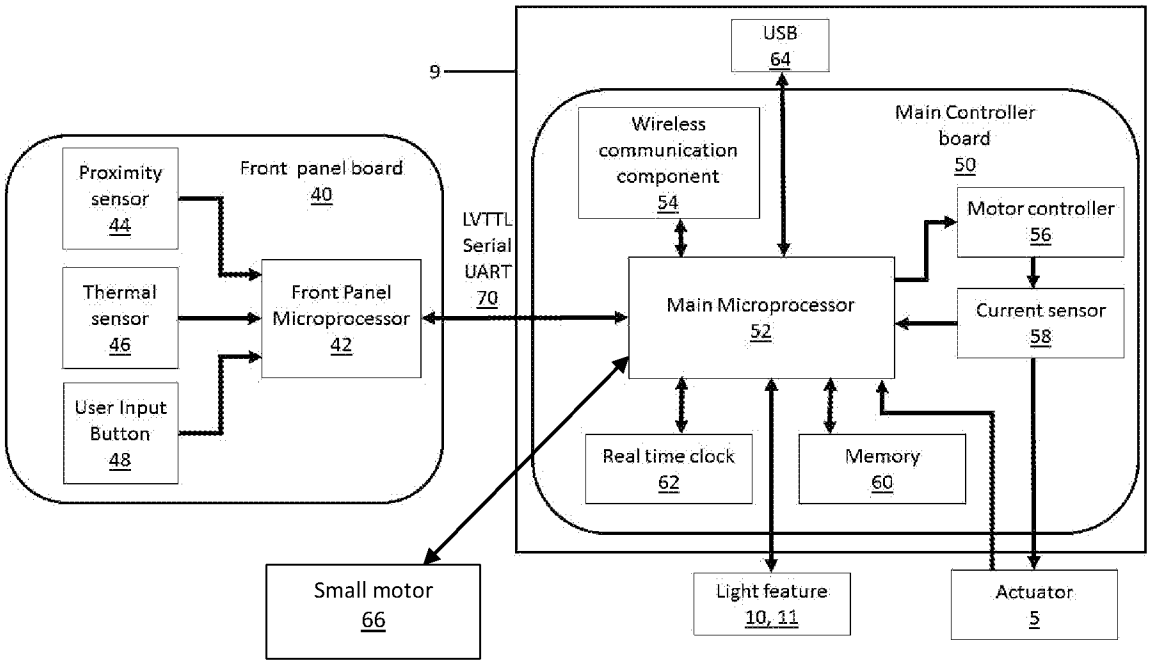
9
USB
64
Wireless communication component
54
Main Controller board
50
Motor controller
56
Current sensor
58
Main Microprocessor
52
Real time clock
62
Memory
60
Light feature
10, 11
Actuator
5
Small motor
66
LVTTL Serial UART
70
Front panel board
40
Proximity sensor
44
Thermal sensor
46
User Input Button
48
Front Panel Microprocessor
42

Fig. 8

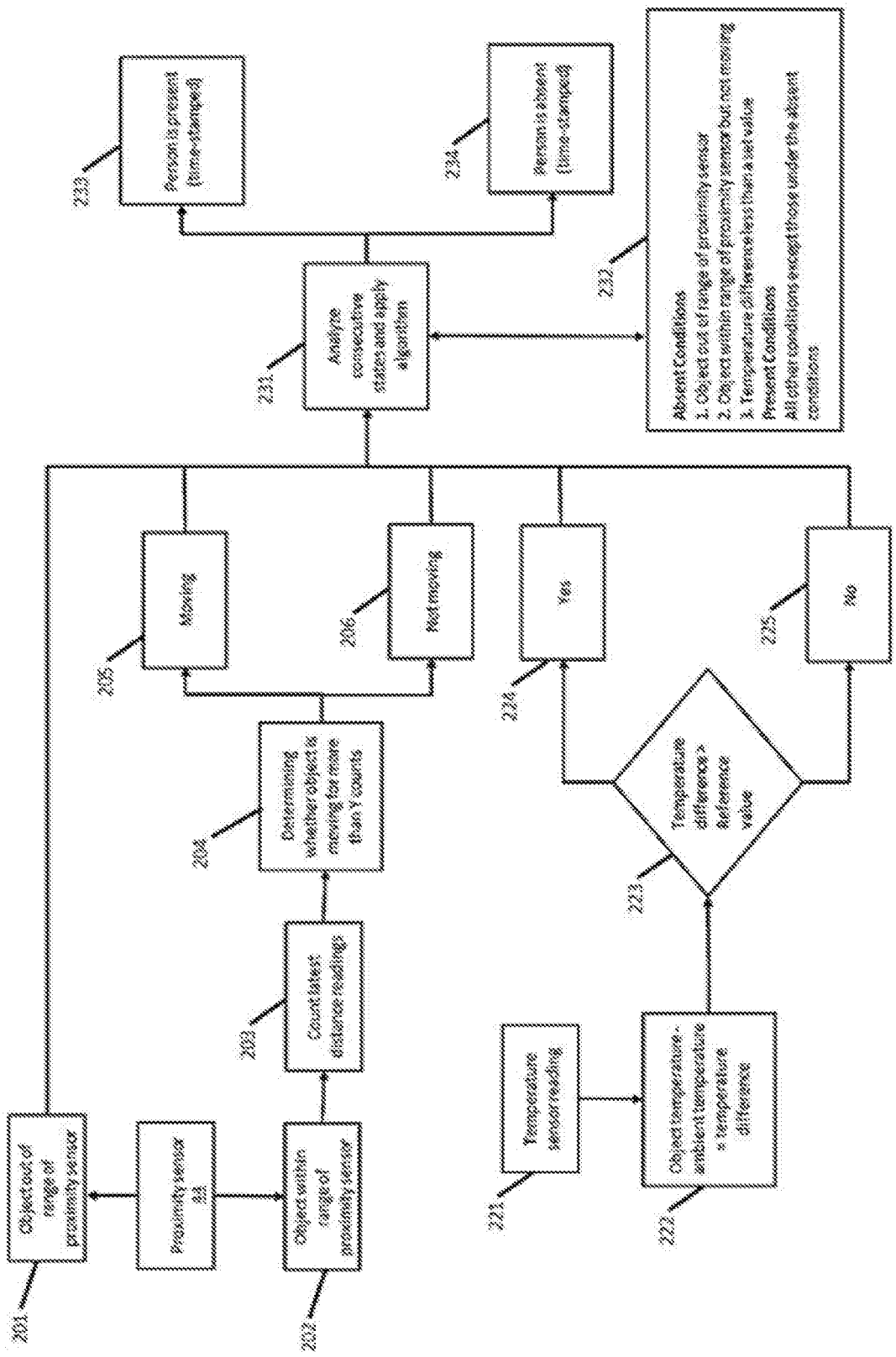
Object out of range of proximity sensor
201
Proximity sensor 33
Object within range of proximity sensor
202
Count latest distance reading
203
Determining whether object is moving for more than Y counts
204
Moving
205
Not moving
206
Object temperature - ambient temperature = temperature difference
222
Temperature sensor reading
221
Temperature difference > reference value
223
Yes
224
No
225
Analyze consecutive states and apply algorithm
231
Absent Conditions
1. Object out of range of proximity sensor
2. Object within range of proximity sensor but not moving
3. Temperature difference less than a set value
Present Conditions
All other conditions except those under the absent conditions
232
Person is absent (time-stamped)
234
Person is present (time-stamped)
233

Fig. 9

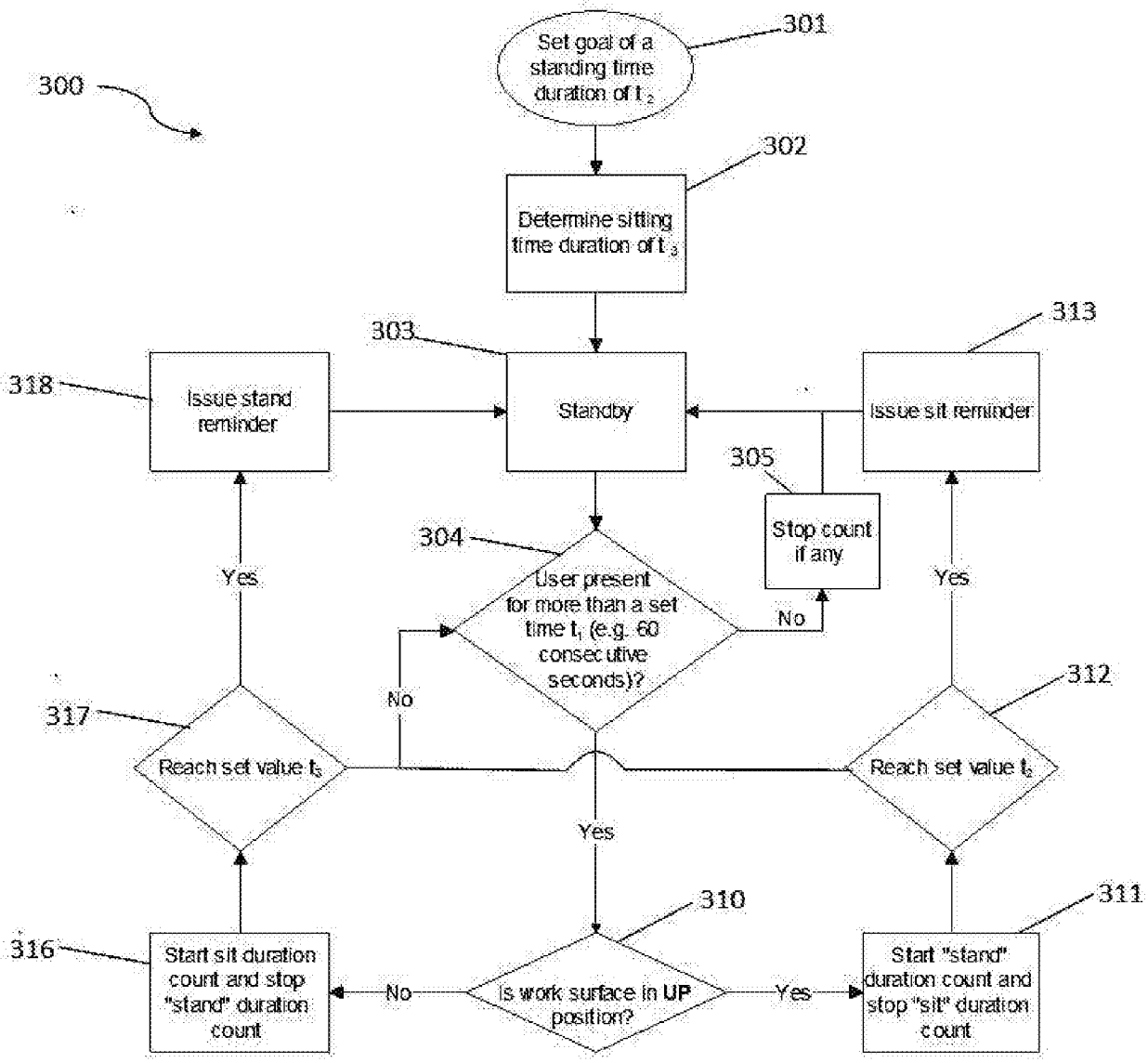
300
301
Set goal of a standing time duration of t_2
302
Determine sitting time duration of t_3
303
Standby
313
Issue sit reminder
318
Issue stand reminder
305
Stop count if any
304
User present for more than a set time t_1 (e.g. 60 consecutive seconds)?
No
Yes
Yes
No
312
Reach set value t_2
317
Reach set value t_3
Yes
310
Is work surface in UP position?
No
Yes
311
Start "stand" duration count and stop "sit" duration count
316
Start sit duration count and stop "stand" duration count

Fig. 10

INTERNATIONAL SEARCH REPORT

International application No.
PCT/SG2017/050258

A. CLASSIFICATION OF SUBJECT MATTER

A47B 21/02 (2006.01) A47B 17/02 (2006.01) A47B 9/00 (2006.01) A47B 97/00 (2006.01)

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

PATENW: IPC/CPC: /LOW A47B2097/005, A47B21/0314, A47B2200/0087, A47B2200/0075, F16M11/046, A63B2220/80, A63B2230/50, A63B2225/50, A47B21/02, A47B17/02, A47B97, F16M11/04, F16M11/28, A47B9, G06F3 and Keywords: SENS+, DETECT+, MONITOR+, OBJECT+, USER+, PRESENC+, ABSENC+, MOTION+, DISTANC+, POSITION+, RECORD+, TRACK+, LOG+, TIME?, TIMING?, TEMP+, HEAT+, AMBIENT+, SURROUND+, KINETIC+, TAP+, VISUAL+, LIGHT+, REMIND+, NOTIF+, NOTIC+, SIT+, STAND+, ADJUST+, CALCULAT+, COMPUT+ and similar terms.

ESPACENET: Applicant/Inventor name(s) searched: "IDEAL WORKSPACE", "IDEAL WORKSPACE PTE LTD", "DENG YUYING", "MCDONNELL ANDREW", "BUTALIA SIDDARTHA", "YANG THOMAS ZHONG MING"

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
	Documents are listed in the continuation of Box C	

[X] Further documents are listed in the continuation of Box C

[X] See patent family annex

* Special categories of cited documents:

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier application or patent but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
4 July 2017	04 July 2017
Name and mailing address of the ISA/AU	**Authorised officer**
AUSTRALIAN PATENT OFFICE PO BOX 200, WODEN ACT 2606, AUSTRALIA Email address: pct@ipaustralia.gov.au	SuMei Van AUSTRALIAN PATENT OFFICE (ISO 9001 Quality Certified Service) Telephone No. 0262256111

INTERNATIONAL SEARCH REPORT C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT		International application No. **PCT/SG2017/050258**
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	KR 1020160025793 A (KORE INSTITUTE FOR EDUCATIONAL POLICY et al.) 09 March 2016, English translation obtained from Korean Intellectual Property Office Abstract; Fig. 1-2, 4; [0010]-[0011], [0021]-[0024], [0043]-[0050], [0057]-[0064]	1-21
X	US 2016/0058186 A1 (CREATING NANO TECHNOLOGIES, INC.) 03 March 2016 Abstract; Fig. 1-4; [0037]-[0043], [0061]	1-21
A	US 2014/0137773 A1 (XEROX CORPORATION) 22 May 2014 Whole Document	1-21
A	US 2014/0096706 A1 (LABROSSE et al.) 10 April 2014 Whole Document	1-15, 19-21
A	US 2016/0213140 A1 (LOGICDATA ELECTRONIC & SOFTWARE ENTWICKLUNGS GMBH) 28 July 2016 Whole Document	1, 3-7, 10-14, 21

INTERNATIONAL SEARCH REPORT Information on patent family members	International application No. **PCT/SG2017/050258**

This Annex lists known patent family members relating to the patent documents cited in the above-mentioned international search report. The Australian Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

Patent Document/s Cited in Search Report		**Patent Family Member/s**	
Publication Number	**Publication Date**	**Publication Number**	**Publication Date**
KR 1020160025793 A	09 March 2016	None	
US 2016/0058186 A1	03 March 2016	US 2016058186 A1	03 Mar 2016
		CN 105380407 A	09 Mar 2016
		TW 201607463 A	01 Mar 2016
		TW I539913 B	01 Jul 2016
US 2014/0137773 A1	22 May 2014	US 2014137773 A1	22 May 2014
		US 8947215 B2	03 Feb 2015
US 2014/0096706 A1	10 April 2014	US 2014096706 A1	10 Apr 2014
		US 9486070 B2	08 Nov 2016
		US 2017042322 A1	16 Feb 2017
US 2016/0213140 A1	28 July 2016	US 2016213140 A1	28 Jul 2016
		DE 102013109830 A1	12 Mar 2015
		EP 3044649 A1	20 Jul 2016
		WO 2015032545 A1	12 Mar 2015

End of Annex

Due to data integration issues this family listing may not include 10 digit Australian applications filed since May 2001.