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(54) Title: THERMAL PROFILE SELECTIONS BASED ON ORIENTATION

(57) Abstract: In an example implementation according to aspects of the present disclosure, a method may include reading data from a sensor disposed within a computing device and, based on the data from the sensor, determining an orientation of the computing device. Base on the orientation, the computing device selects a thermal profile for operating the computing device.



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THERMAL PROFILE SELECTIONS BASED ON ORIENTATION

BACKGROUND

[0001] The emergence and popularity of mobile computing, particularly due to their compact design and light weight, has made computing devices portable. As a result, computing devices, such as thin clients, may be operated in various orientations, for example, according to the preference of users. For example, thin clients may be operated in horizontal or vertical orientations, or even disposed behind a monitor (bezel orientation). As a computing device operates in one of these various operations, the stress associated with components disposed within the computing device, for example, due to temperature, may vary, based on the orientation. It is desirable to avoid extreme temperatures for the components, in order to avoid premature failure of the computing device.

BRIEF DESCRIPTION OF THE DRAWINGS

[0002] FIG. 1 illustrates a computing device for selecting a thermal profile, based on an orientation of the computing device, according to an example;

[0003] FIG. 2 illustrates a method at a computing device for selecting a thermal profile for operating the computing device, based on the orientation of the computing device, according to an example; and

[0004] FIG. 3 is a flow diagram in accordance with an example of the present disclosure.

DETAILED DESCRIPTION

[0005] Examples disclosed herein provide the ability to select a thermal profile for operating the computing device, based on the orientation of the computing device. By selecting a thermal profile based on the orientation of the computing device, performance of the computing device may be optimized while operating in that particular orientation. Examples of settings that may be adjusted for a thermal profile include, but are not limited to, tuning throttle points, central processing unit (CPU) boost frequencies, and a fan speed profile. By adjusting these settings, based on the orientation of the computing device, quieter operations may be possible, in

addition to improved CPU performance. As will be further described, stress associated with the components disposed within the computing device may also be reduced when the appropriate thermal profile is selected, resulting in more reliable and prolonged use of the computing device.

[0006] With reference to the figures, FIG. 1 illustrates a computing device 100 for selecting a thermal profile, based on an orientation of the computing device 100, according to an example. As an example, sensor 102 disposed within the computing device 100, for example, on the motherboard, may be used for determining the orientation of the computing device 100. The computing device 100 depicts a processor 104 and a memory device 106 and, as an example of the computing device 100 performing its operations, the memory device 106 may include instructions 108-110 that are executable by the processor 104. Thus, memory device 106 can be said to store program instructions that, when executed by processor 104, implement the components of the computing device 100. The executable program instructions stored in the memory device 106 include, as an example, instructions to determine orientation (108) and instructions to select thermal profile (110).

[0007] Instructions to determine orientation (108) represent program instructions that when executed by the processor 104 cause the computing device 100 to determine an orientation of the computing device 100. As mentioned above, the sensor 102 may be used to determine the system orientation. For example, upon reading data from the sensor 102, the computing device 100 may determine its orientation based on the data read. As an example, the sensor 102 may be an accelerometer, but could also be another type of sensor that determines orientation.

[0008] As an example, the computing device 100 may have at least six different operating orientations. The first two may correspond to horizontal orientations, with a particular side of the computing device 100 facing up in one of the orientations (H+), then facing down in the other orientation (H-). As an example, the sensor 102 may be able to distinguish between H+ and H-. The next two orientations may correspond to vertical orientations, with the particular side of the computing device

100 facing left in one of the orientations (V+), then facing right in the other orientation (V-). As an example, the sensor 102 may be able to distinguish between V+ and V-.

[0009] Finally, the last two orientations may correspond to bezel orientations, where, for example, the computing device 100 is disposed behind a monitor. As an example, the bezel orientations may vary from the vertical orientations by being rotated 90 degrees, for example, in order to have accessibility to the power button on the computing device. As an example, the power button may be facing up in one of the orientations (B+), then facing down in the other orientation (B-). As an example, the sensor 102 may be able to distinguish between B+ and B-. As a result, in addition to determining when the computing device 100 is in one of the horizontal orientations, the sensor 102 may be able to distinguish when the computing device 100 is in either one of the vertical orientations or bezel orientations.

[0010] As will be further described, rather than utilizing a single thermal profile, irrespective of the orientation of the computing device 100, relying on the orientation of the computing device 100 to select a thermal profile, performance of the computing device may be optimized while operating in that particular orientation. For example, if utilizing a single thermal profile irrespective of orientation, the thermal profile selected may be for the orientation producing the least desirable thermal environment. As a result, factors such as the fan speed, CPU boost frequency, and throttle points, may be set sub optimally for the other five orientations, which may not be desirable.

[0011] As an example, the frequency that the computing device 100 determines its orientation may vary. For example, the orientation may be determined once upon startup, for example, during a power-on self-test (POST). However, the orientation may be determined dynamically, even after a POST. This may be particularly useful if the orientation of the computing device 100 is changed often after it is powered on. As a result, the thermal profile may be changed dynamically, as will be further described.

[0012] Instructions to select thermal profile (110) represent program instructions that when executed by the processor 104 cause the computing device 100 to select a thermal profile for operating the computing device 100, based on the orientation of

the computing device 100. As mentioned above, the frequency that the thermal profile is changed may be dependent on the frequency that the orientation is determined. For example, if the orientation is determined only during a POST, the thermal profile selected will be based on orientation of the computing device 100 when it is powered on. However, if the orientation is determined dynamically, for example, anytime a user changes the orientation of the computing device 100, such as switching from a horizontal orientation to a vertical orientation, the appropriate thermal profile may be selected dynamically as well. As a result, factors such as the throttle points, CPU boost frequencies, and fan speed profile may be tuned to optimize performance of the computing device 100 when in that particular orientation.

[0013] As an example, rather than relying on the sensor 102 to determine the orientation of the computing device 100, the computing device 100 may receive input from a user indicating an orientation of the computing device 100. For example, the user may be able to select the system orientation in the BIOS (e.g., F10 setup). Based on the orientation indicated by the user, the computing device 100 may select a thermal profile for operating the computing device 100, based on the orientation indicated by the user.

[0014] Memory device 106 represents generally any number of memory components capable of storing instructions that can be executed by processor 104. Memory device 106 is non-transitory in the sense that it does not encompass a transitory signal but instead is made up of at least one memory component configured to store the relevant instructions. As a result, the memory device 106 may be a non-transitory computer-readable storage medium. Memory device 106 may be implemented in a single device or distributed across devices. Likewise, processor 104 represents any number of processors capable of executing instructions stored by memory device 106. Processor 104 may be integrated in a single device or distributed across devices. Further, memory device 106 may be fully or partially integrated in the same device as processor 104, or it may be separate but accessible to that device and processor 104.

[0015] In one example, the program instructions 108-110 can be part of an installation package that when installed can be executed by processor 104 to implement the components of the computing device 100. In this case, memory device 106 may be a portable medium such as a CD, DVD, or flash drive or a memory maintained by a server from which the installation package can be downloaded and installed. In another example, the program instructions may be part of an application or applications already installed. Here, memory device 106 can include integrated memory such as a hard drive, solid state drive, or the like.

[0016] FIG. 2 illustrates a method 200 at a computing device for selecting a thermal profile for operating the computing device, based on the orientation of the computing device, according to an example. As mentioned above, a computing device, such as a thin client, may have at least six different operating orientations (e.g., H+, H-, V+, V-, B+, B-). By selecting a thermal profile based on the orientation of the computing device, performance of the computing device may be optimized while operating in that particular orientation. In discussing FIG. 2, reference may be made to the example computing device 100 illustrated in FIG. 1. Such reference is made to provide contextual examples and not to limit the manner in which method 200 depicted by FIG. 2 may be implemented.

[0017] Method 200 begins at 202, where the computing device determines an orientation of the computing device. Referring to computing device 100, sensor 102 disposed within the computing device 100, for example, on the motherboard, may be used for determining the orientation of the computing device 100. The frequency that the computing device determines its orientation may vary. For example, the orientation may be determined once upon startup, for example, during a POST. However, the orientation may be determined dynamically, even after a POST, as will be illustrated at 206. This may be particularly useful if the orientation of the computing device is changed often after it is powered on.

[0018] At 204, the computing device selects a thermal profile for operating the computing device, based on the determined orientation. Examples of settings that may be adjusted for a thermal profile include, but are not limited to, tuning throttle points, CPU boost frequencies, and a fan speed profile. By adjusting these settings,

based on the orientation of the computing device, quieter operations may be possible, in addition to improved CPU performance. In addition, stress associated with the components disposed within the computing device may also be reduced when the appropriate thermal profile is selected, resulting in more reliable and prolonged use of the computing device. For example, the thermal profile selected for a particular orientation may provide ideal operating conditions for the components within the computing device, while in that orientation, avoiding extreme temperatures.

[0019] At 206, the computing device determines whether the orientation of the computing device has changed, for example, from a first orientation to a second orientation. If so, the computing device returns to 204, to select the thermal profile for operating the computing device while in the second orientation. As an example, the thermal profile for operating the computing device while in the second orientation may be different from the thermal profile for operating the computing device while in the first orientation. As a result, performance of the computing device may be dynamically optimized, based on the orientation that the computing device is currently in.

[0020] FIG. 3 is a flow diagram 300 of steps taken by a computing device to implement a method for selecting a thermal profile for operating the computing device, based on the orientation of the computing device, according to an example. Although the flow diagram of FIG. 3 shows a specific order of execution, the order of execution may differ from that which is depicted. For example, the order of execution of two or more blocks or arrows may be scrambled relative to the order shown. Also, two or more blocks shown in succession may be executed concurrently or with partial concurrence. All such variations are within the scope of the present invention.

[0021] At 310, the computing device reads data from a sensor disposed within the computing device. As described above, the computing device may read data from the sensor during a POST. Otherwise, the computing device may read data from the sensor continuously, or at certain intervals, in order to determine anytime there is a change in the orientation.

[0022] At 320, based on the data from the sensor, the computing device determines an orientation of the computing device (e.g., first orientation). As described above, the computing device may have at least six different operating orientations (e.g., H+, H-, V+, V-, B+, B-). As an example, in addition to determining when the computing device is in one of the horizontal orientations, the sensor may be able to distinguish when the computing device is in either one of the vertical orientations or bezel orientations.

[0023] At 330, based on the first orientation, the computing device selects a first thermal profile for operating the computing device. Settings adjusted for the first thermal profile generally include tuning throttle points, CPU boost frequencies, and a fan speed profile, for example, to optimize performance of the computing device while in the first orientation.

[0024] While operating according to the first thermal profile, the computing device may determine a change in orientation of the computing device from the first orientation to a second orientation, for example, upon reading data from the sensor. Based on the second orientation, the computing device selects a second thermal profile, different from the first thermal profile, for operating the computing device while in the second orientation. Similar to the first thermal profile, settings adjusted for the second thermal profile generally include tuning the throttle points, the CPU boost frequencies, and the fan speed profile, to optimize performance of the computing device while in the second orientation. In addition to determining a change in orientation, based on data received from the sensor, the computing device may also receive input from a user, indicating an orientation of the computing device (e.g., via BIOS). Based on the orientation indicated by the user, the computing device selects a thermal profile for operating the computing device.

[0025] It is appreciated that examples described may include various components and features. It is also appreciated that numerous specific details are set forth to provide a thorough understanding of the examples. However, it is appreciated that the examples may be practiced without limitations to these specific details. In other instances, well known methods and structures may not be described in detail to

avoid unnecessarily obscuring the description of the examples. Also, the examples may be used in combination with each other.

[0026] Reference in the specification to "an example" or similar language means that a particular feature, structure, or characteristic described in connection with the example is included in at least one example, but not necessarily in other examples. The various instances of the phrase "in one example" or similar phrases in various places in the specification are not necessarily all referring to the same example.

[0027] It is appreciated that the previous description of the disclosed examples is provided to enable any person skilled in the art to make or use the present disclosure. Various modifications to these examples will be readily apparent to those skilled in the art, and the generic principles defined herein may be applied to other examples without departing from the scope of the disclosure. Thus, the present disclosure is not intended to be limited to the examples shown herein but is to be accorded the widest scope consistent with the principles and novel features disclosed herein.

CLAIMS

WHAT IS CLAIMED IS:

1. A method comprising:
reading data from a sensor disposed within a computing device;
based on the data from the sensor, determining a first orientation of the computing device; and
based on the first orientation, selecting a first thermal profile for operating the computing device.
2. The method of claim 1, wherein reading data from the sensor occurs during a power-on self-test (POST).
3. The method of claim 1, wherein the reading data from the sensor occurs continuously or at fixed intervals.
4. The method of claim 3, comprising:
while the computing device is operating according to the first thermal profile, determining a change in orientation of the computing device from the first orientation to a second orientation; and
based on the second orientation, selecting a second thermal profile, different from the first thermal profile, for operating the computing device while in the second orientation.
5. The method of claim 4, wherein settings adjusted for the first thermal profile comprise tuning throttle points, central processing unit (CPU) boost frequencies, and a fan speed profile, to optimize performance of the computing device while in the first orientation.
6. The method of claim 5, wherein settings adjusted for the second thermal profile comprise tuning the throttle points, the CPU boost frequencies, and the fan speed profile, to optimize performance of the computing device while in the second orientation.

7. The method of claim 1, comprising:
 - receiving input from a user indicating an orientation of the computing device;
 - and
 - based on the orientation indicated by the user, selecting a thermal profile for operating the computing device.
8. A computing device comprising:
 - a sensor; and
 - a processor to:
 - read data from the sensor;
 - based on the data from the sensor, determine a first orientation of the computing device;
 - based on the first orientation, select a first thermal profile for operating the computing device;
 - while the computing device is operating according to the first thermal profile, determine a change in orientation of the computing device from the first orientation to a second orientation; and
 - based on the second orientation, select a second thermal profile, different from the first thermal profile, for operating the computing device while in the second orientation.
9. The computing device of claim 8, wherein settings adjusted for the first thermal profile comprise tuning throttle points, central processing unit (CPU) boost frequencies, and a fan speed profile, to optimize performance of the computing device while in the first orientation.
10. The computing device of claim 9, wherein settings adjusted for the second thermal profile comprise tuning the throttle points, the CPU boost frequencies, and the fan speed profile, to optimize performance of the computing device while in the second orientation.

11. A non-transitory computer-readable storage medium comprising program instructions which, when executed by a processor, cause the processor to:
- determine an orientation of a computing device, based on data read from a sensor disposed within the computing device; and
 - select a thermal profile for operating the computing device, based on the orientation of the computing device.
12. The non-transitory computer-readable storage medium of claim 11, comprising program instructions which, when executed by the processor, cause the processor to read the data from the sensor during a power-on self-test (POST).
13. The non-transitory computer-readable storage medium of claim 11, comprising program instructions which, when executed by the processor, cause the processor to read the data from the sensor continuously or at fixed intervals.
14. The non-transitory computer-readable storage medium of claim 13, comprising program instructions which, when executed by the processor, cause the processor to:
- while the computing device is operating according to a first thermal profile, determine a change in orientation of the computing device from a first orientation to a second orientation; and
 - based on the second orientation, select a second thermal profile, different from the first thermal profile, for operating the computing device while in the second orientation.
15. The non-transitory computer-readable storage medium of claim 11, comprising program instructions which, when executed by the processor, cause the processor to:
- receive input from a user indicating an orientation of the computing device; and
 - based on the orientation indicated by the user, select a thermal profile for operating the computing device.

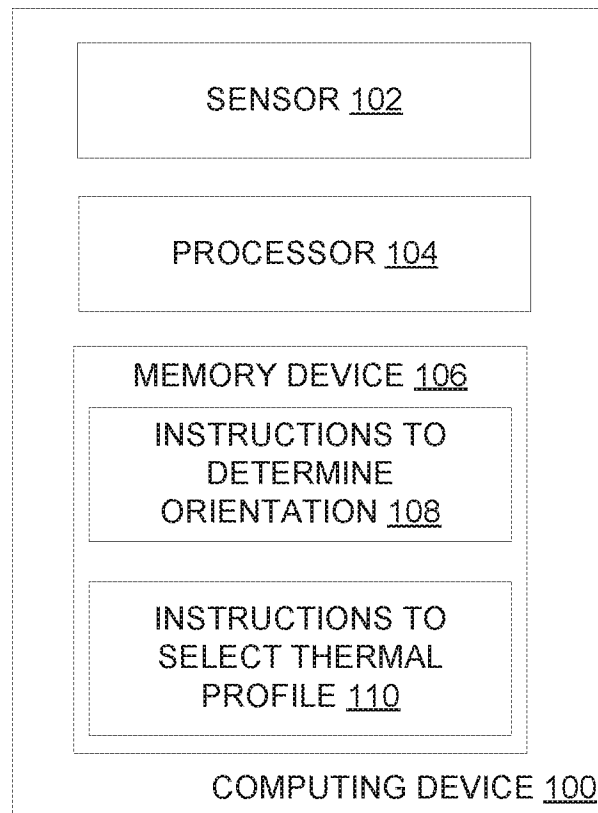


FIG. 1

2/3

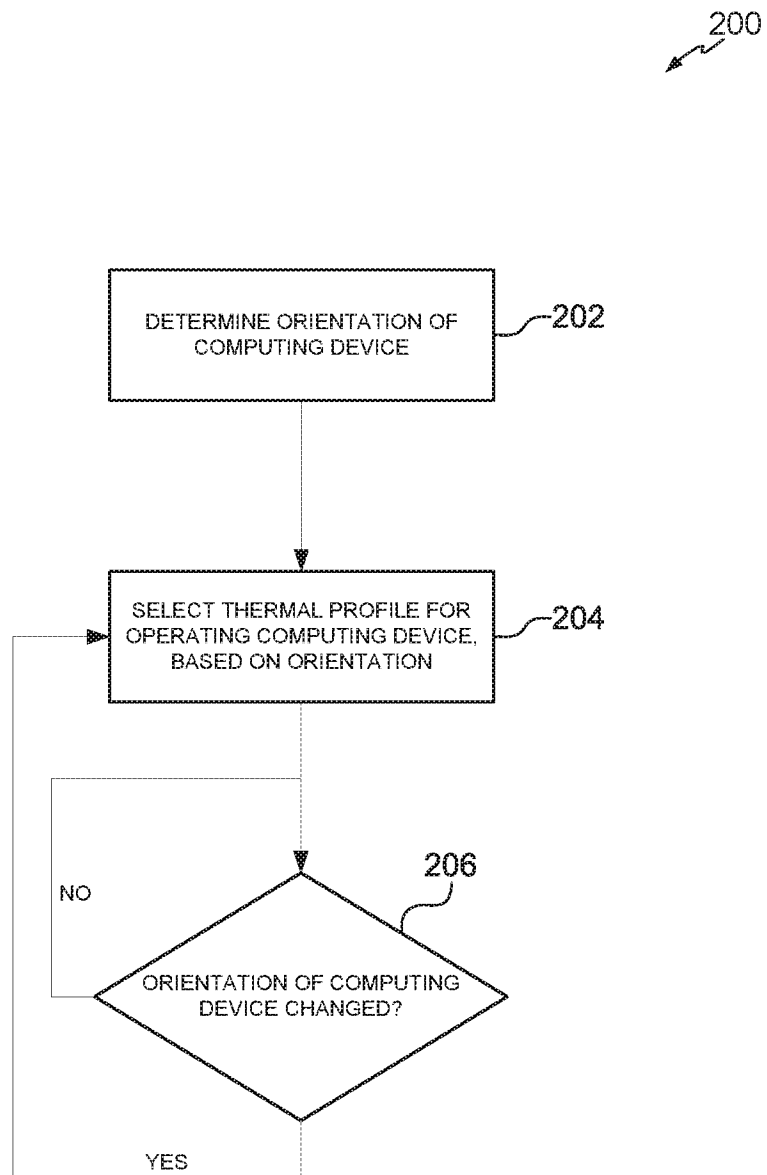


FIG. 2

3/3

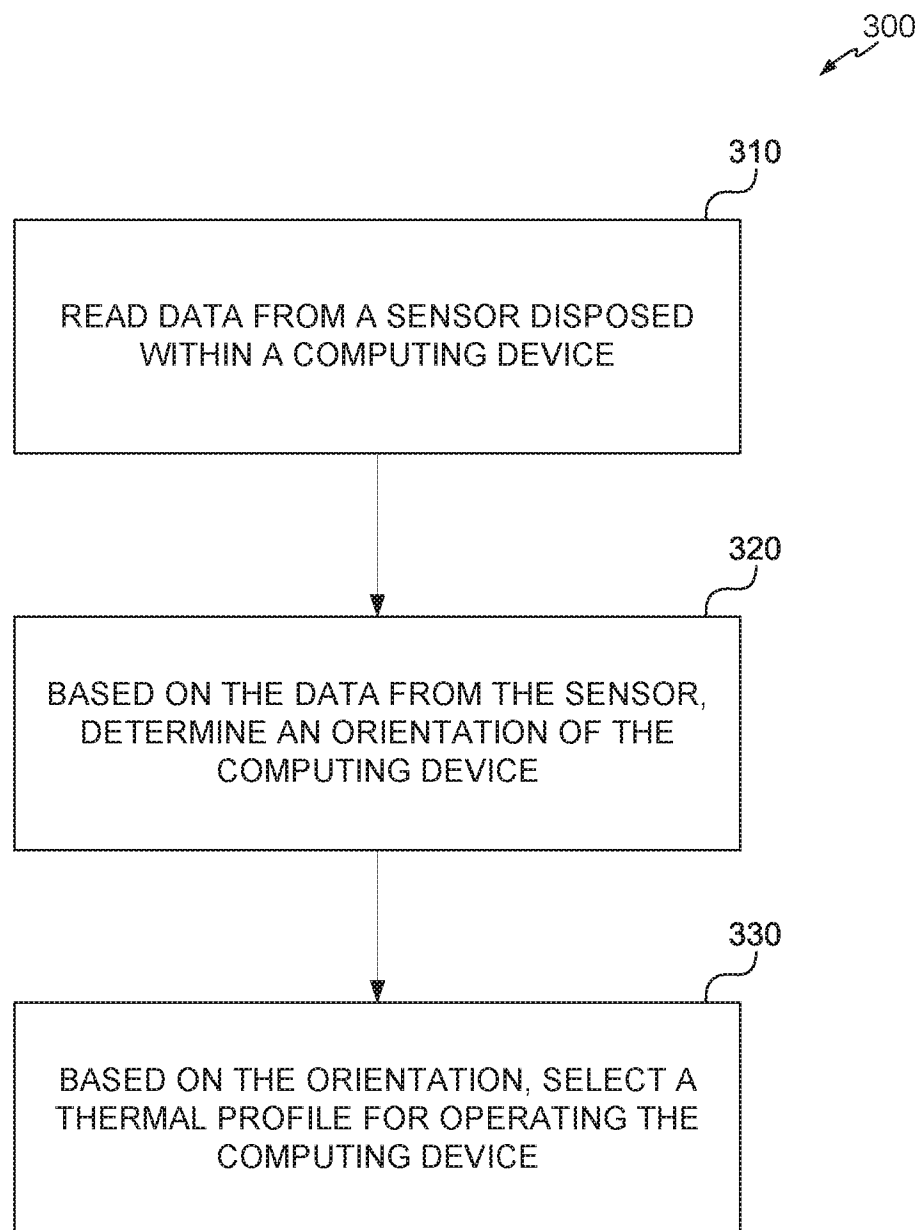


FIG. 3

INTERNATIONAL SEARCH REPORT

International application No.

PCT/US 2018/040219

A. CLASSIFICATION OF SUBJECT MATTER <i>G06F 1/20 (2006.01)</i> 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) G06F 1/00, 1/16, 3/00, 3/01, 3/0346, G01K 13/00, 15/00, H04N 5/00, 5/222, 5/33, G06T 1/00, 1/20, A61B 5/00, 5/01, 5/16, G01J 5/00, 5/02, 5/12, H04M 1/00, 1/24, 1/725 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) PatSearch (RUPTO Internal), USPTO, PAJ, Espacenet, Information Retrieval System of FIPS		
C. DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 2011/0273378 A1 (RACHID ALAMEH et al.) 10.11.2011, paragraphs [0018], [0019], [0020], [0024], [0026], [0029], [0030], [0046], [0057], [0058], [0059], [0064], [0065], [0066], [0068], [0069], [0070]	1-4, 7, 8, 11-15
Y		5, 6, 9, 10
Y	US 2015/0348226 A1 (APPLE INC.) 03.12.2015, paragraphs [0025], [0029], [0030], [0031]	5, 6, 9, 10
A	US 2013/0109371 A1 (HU-DO LTD.) 02.05.2013	1-15
A	US 6029119 A (COMPAQ COMPUTER CORPORATION) 22.02.2000	1-15
A	US 2016/0360970 A1 (FACENSE LTD.) 15.12.2016	1-15
☐ Further documents are listed in the continuation of Box C. ☐ See patent family annex.		
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"P" document published prior to the international filing date but later than the priority date claimed		
Date of the actual completion of the international search	Date of mailing of the international search report	
23 January 2019 (23.01.2019)	28 March 2019 (28.03.2019)	
Name and mailing address of the ISA/RU: Federal Institute of Industrial Property, Berezhkovskaya nab., 30-1, Moscow, G-59, GSP-3, Russia, 125993 Facsimile No: (8-495) 531-63-18, (8-499) 243-33-37	Authorized officer E. Lukicheva Telephone No. 8(495) 531-64-81	