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(54) Title: SPLIT SCREEN FEATURE FOR MACRO PHOTOGRAPHY

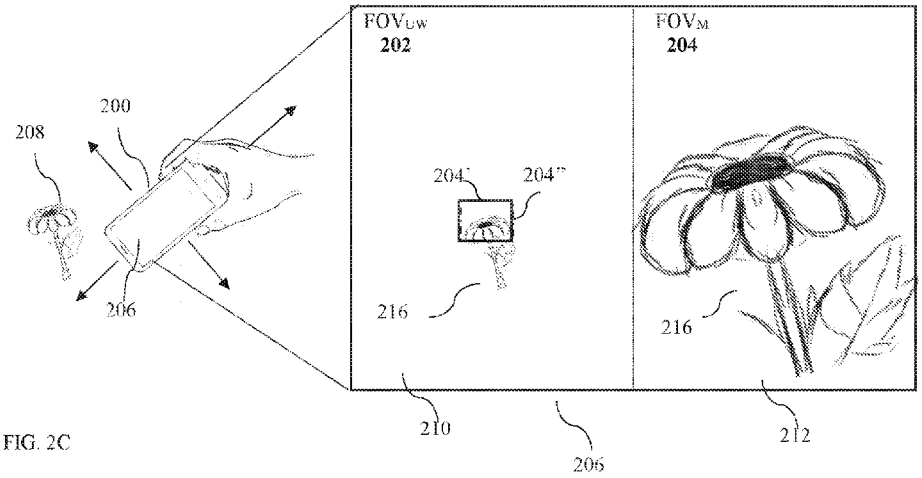


FIG. 2C

(57) Abstract: Mobile electronic devices comprising a first camera with a first field of view FOV$_1$, a second, Macro camera with a Macro field of view FOV$_M$ smaller than FOV$_1$, and a device screen that includes a first screen section configured to display first image data from the first camera and a second screen section configured to display second image data from the Macro camera when both cameras are focused to a distance equal to or smaller than 30cm.

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SPLIT SCREEN FEATURE FOR MACRO PHOTOGRAPHY

CROSS REFERENCE TO RELATED APPLICATIONS

This application claims the benefit of priority from U.S. Provisional patent applications No. 62/980,184 filed 22 February 2020, 63,032,576 filed 30 May 2020, and 63,080,047 filed 18 September 2020, all of which are incorporated herein by reference in their entirety.

FIELD

The subject matter disclosed herein relates in general to Macro images and in particular to methods for obtaining such images with multi-cameras (e.g. dual-cameras).

BACKGROUND

Multi-aperture digital cameras (or multi-cameras) are standard for mobile electronic devices (e.g. smartphones, tablets, etc.). A multi-camera usually comprises a camera with a wide field-of-view (or "angle") FOV_W ("Wide" camera), and at least one additional camera, either with the same FOV (e.g. a depth auxiliary camera), with a narrower (than FOV_W) field of view FOV_T (Telephoto or "Tele" camera), or with an ultra-wide field of view FOV_{UW} wider than FOV_W ("UW camera"). In some embodiments below, a Wide or Ultra-Wide camera may be referred to as a "non-Macro camera".

A "Macro-photography" mode is becoming a popular differentiator for smartphone cameras. "Macro-photography" refers to photographing objects that are very close to the camera, so that the image size of an object recorded on the image sensor is nearly as large as the actual size of the object photographed, i.e. it has a large object : image magnification (M) of e.g. 10:1 to 1:1. Such an image may be referred to as "Macro image". First smartphones that include a Macro camera with a Macro FOV (FOV_M), often based on an UW camera have entered the consumer market. A Macro camera can be realized with a Tele camera. An advantage is the high magnification M of a Macro images captures with a Tele camera, so that one may speak of a "Super Macro Image". In some examples, the Macro camera may be a scanning Tele camera which can

scan a scene with its native FOV_M, for example as described in co-owned US patent 10,578,948.

Macro images are recorded at very small object-camera distances of around 20cm or less. A UW camera may still be capable to focus to these small distances. Generally, very small objects (e.g., less than 1cm in size) are targeted as image objects (i.e. are objects of interest or "OOIs"). Such very small OOIs for a Macro image may be occluded by the multi-camera hosting device, making it difficult to point the Macro camera to capture the OOI in a precise manner. This is especially significant when FOV_M captures a small area (e.g. a few square millimeters) of an object (e.g., placed 2cm to 10cm away from the camera) while being integrated in a large device. It would be beneficial to have a method that supports a quick and user-friendly way to direct a Macro camera FOV_M towards very small OOIs.

SUMMARY

In some embodiments there is provided a split screen view on a multi-camera hosting device showing a preview image segment of an ultra-wide camera FOV together with a preview image segment of the FOV_M to support the targeting of an OOI with the FOV_M.

The image segment of an ultra-wide camera FOV being displayed to the user may contain some differentiating element marking the area of the OOI that is to be captured by the Macro mode. Such differentiating element marking may include a touchable box, for example a rectangular box. The user may get a feedback on the screen in which direction the multi-camera hosting device is to be moved to catch the OOI with the FOV_M.

In various embodiments there are provided mobile electronic devices, comprising a first camera with a first field of view FOV_1, a second, Macro camera with a Macro field of view FOV_M smaller than FOV_1 and a device screen that includes a first screen section configured to display first image data from the first camera and a second screen section configured to display second image data from the Macro camera when both cameras are focused to a distance equal to or smaller than 30cm.

In some embodiments, the FOV_M is shown and marked within the first screen section.

In some embodiments, the first screen section includes a visual indication for guiding a user of the mobile electronic device towards a scene using the FOV_M.

In some embodiments, the second screen section displays first image data from the first camera.

In some embodiments, a device further comprises a controller for controlling a change in state of the Macro camera based on the first image data. In some embodiments, the state of the Macro camera is a zoom state. In some embodiments, the state of the Macro camera is a focus state.

In some embodiments, the first camera has a focal length between 2 and 7mm.

In some embodiments, the Macro camera has a focal length between 12 and 40mm.

In some embodiments, the Macro camera has a focal length between 14 and 30mm.

In some embodiments, the Macro camera has a focal length between 15 and 20mm.

In some embodiments, both cameras can be focussed to a distance smaller than 20cm.

In some embodiments, both cameras can be focused to a distance of 10cm or less.

In some embodiments, at least one camera can be focused to a distance between 5 and 10cm.

In some embodiments, at least one camera can be focused to a distance of 5cm or less.

In some embodiments, at least one camera can be focused to a distance of 3cm or less.

In some embodiments, the first camera is an Ultra-Wide camera.

In some embodiments, the first camera is a Wide camera.

In some embodiments, the Macro camera is a scanning Tele camera. In some embodiments, the device further comprises a controller for controlling a change of a scan state of the Macro camera based on the first image data.

In some embodiments, the Macro camera is a Tele camera having different zoom states.

In some embodiments, the first camera is focused to a first distance different from a second distance that the Macro camera is focused to.

In some embodiments, the first screen section and the second screen section are split vertically when the mobile electronic device is held in a landscape orientation, and the first screen section and the second screen section are split horizontally when the mobile electronic device is held in a portrait orientation.

In some embodiments, the device is a smartphone.

In some embodiments, the device further comprises a controller for controlling a change of a scan state of the Macro camera based on the first image data.

In various embodiments there are provided methods, comprising providing a mobile electronic device that includes a first camera with a first field of view FOV_1, a second, Macro camera with a Macro field of view FOV_M smaller than FOV_1, and a device screen, focusing the first camera and the Macro camera to a distance ≤ 30cm, and displaying on a first section of the device screen first image data from the first camera and displaying on a second section of the device screen second image data from the second camera.

In some embodiments, the focusing of the first camera and of the Macro camera to a distance ≤ 30cm includes focusing the first camera to a first distance ≤ 30cm and focusing the Macro camera to a distance ≤ 30cm different from the first distance.

In some embodiments, the focusing of the first camera and of the Macro camera to a distance ≤ 30cm includes focusing both cameras to a distance of 20cm or less.

In some embodiments, the focusing of the first camera and of the Macro camera to a distance ≤ 30cm includes focusing both cameras to a distance of 10cm or less.

In some embodiments, the focusing of the first camera and of the Macro camera to a distance ≤ 30cm includes focusing both cameras or one of the cameras to a distance of 5cm or less.

In some embodiments, the focusing of the first camera and of the Macro camera to a distance ≤ 30cm includes focusing both cameras or one of the cameras to a distance of 3cm or less.

In some embodiments, a method further comprises showing and marking the FOV_M within the first screen section.

In some embodiments, a method further comprises including in the first screen section a visual indication for guiding a user of the mobile electronic device towards a scene using the FOV_M.

In some embodiments, a method further comprises displaying the first image data in the second screen section.

In some embodiments, a method further comprises controlling a change in state of the Macro camera based on the first image data.

In some embodiments, the controlling a change in state of the Macro camera includes controlling a change of a state selected from the group consisting of a scan state, a zoom state and a focus state of the Macro camera.

In some embodiments, the Macro camera is a scanning Tele camera and the controlling a change in state of the Macro camera based on the first image data includes automatically controlling a change of a scan state of the scanning Tele camera.

In some embodiments, the Macro camera is a Tele camera having different zoom states and the controlling a change in state of the Macro camera includes automatically controlling a change of a zoom state of the Tele camera.

BRIEF DESCRIPTION OF THE DRAWINGS

Non-limiting examples of embodiments disclosed herein are described below with reference to figures attached hereto that are listed following this paragraph. The drawings and descriptions are meant to illuminate and clarify embodiments disclosed herein, and should not be considered limiting in any way. Like elements in different drawings may be indicated by like numerals. Elements in the drawings are not necessarily drawn to scale.

FIG. 1 shows schematically dual-camera output image sizes and ratios between an ultra-wide FOV and a Macro FOV;

FIG. 2A illustrates a smartphone having an ultra-wide camera, a Macro camera, and a screen split into two sections, one exhibiting FOV_{UW} (or a cropped area of it) and one exhibiting FOV_M (or a cropped area of it), according to an embodiment disclosed herein;

FIG. 2B illustrates a first stage in a process of moving the smartphone and the FOV_M in the camera of FIG. 2A towards an OOI, as seen in each section of the screen;

FIG. 2C illustrates a final stage in the process of moving the smartphone and the FOV_M in the camera of FIG. 2A towards an OOI, as seen in each section of the screen;

FIG. 3 shows a split screen view according to another embodiment disclosed herein;

FIG. 4 shows in a flow chart of a method of use of a split screen for Macro-photography in a mobile electronic device, according to embodiments disclosed herein;

FIG. 5 shows schematically an embodiment of an electronic device including a multi-camera and configured to perform methods disclosed herein.

DETAILED DESCRIPTION

Embodiments disclosed herein solve the problem of occlusion of an object of interest when Macro-photography is performed with multi-cameras included in smartphones and other mobile electronic devices. For simplicity and for example only, the solution is illustrated with a dual-camera, with the understanding that it is also clearly applicable with multi-cameras having three or more cameras.

FIG. 1 illustrates a typical field of-view (FOV) ratio of smartphone **100** including a multi-camera (not shown) that includes a UW camera with a FOV_{UW} **102** covering a large segment of a scene and a Macro camera with a FOV_M **104** covering a small segment of a scene. One can see exemplary sizes and ratios between UW and Macro output images.

In some examples, the Macro camera may be a continuous Tele zoom camera where FOV_M changes with changing ZF.

FIG. 2A illustrates an embodiment numbered **200** of a smartphone having a UW camera with a FOV_{UW} **202** and a Macro camera with a FOV_M **204** and a screen (display) **206** according to presently disclosed subject matter. A system description of smartphone **200** is given in FIG. 5. As indicated by four arrows in FIG. 2A-C, smartphone **200** may be moved by a user in four or more directions for manually moving FOV_M towards an OOI/ROI. Screen **206** illustrates a first screen example for displaying images of a multi-camera. Macro photography is required to capture small objects from a close range. The Macro camera may include a Tele lens with a focal length much larger (e.g., 3 times to 25 times) than the focal length of the UW camera. In such a case, the UW camera can easily focus to a close range (e.g. 2cm to 30cm), but its spatial resolution is poor since its focal length is small and its FOV is large. For example, consider a UW camera with 2.5mm focal length and a Macro camera with 25mm focal length. The two cameras may include identical or different sensors (e.g., with identical or different pixel count and pixel size). Assume that both cameras include the same sensor, e.g., with 4mm active image sensor width. When focused to 5cm, the Macro camera will have a M of 1:1 and will capture an object width of 4mm (same as the sensor width). The UW camera will have a M of 19:1 and will capture an object width of 76mm.

In some examples, for performing a method disclosed herein, a smartphone like smartphone **200** may comprise, instead of or additionally to the UW camera with FOV_{UW} **202**, a W camera with a FOV_W (not shown) that is smaller than FOV_{UW} **202** but still larger than FOV_M.

In some examples, the W camera may not be able to focus to an object as close as e.g. 10 cm. In such examples, for performing a method disclosed herein, the W camera may be focused to its minimal focus distance, e.g. to 20cm.

The UW or W cameras mentioned above have a larger depth of field than a Macro capable Tele camera with FOV_M. A ROI is easier to detect in UW or W image data than in Macro image data. Therefore, one may use UW or W or M camera image data for automatic ROI detection and selection.

In an exemplary case, a user wishes to use smartphone **200** for capturing an OOI (e.g. a flower **208** which forms an image **216** in a camera) or a ROI with very high (Macro) resolution. For methods of use as disclosed herein, screen **206** is split into two sections, a first section **210** (possibly cropped) and a second section **212**. The first screen section may display first image data from the first camera with FOV_1 and the second screen section may display second image data from the second camera with FOV_M. The examples here show a "split screen" view on the screen, i.e. the two screen sections are shown side by side. In other examples (not shown) one may display a "picture-in-picture" view on the screen, i.e. one screen section may be shown as an inlay in the other screen section. In some examples, the second screen section may be shown on the entire screen or on a large segment of the screen except on a segment where the first screen section is shown, and wherein the first screen section covers a smaller area on the screen than the second screen. In the embodiment of FIGS. 2A-2C, the two screen sections have exemplarily a "landscape" orientation, i.e. first screen section and the second screen section are split vertically, beneficial when the device is held in landscape orientation. Screen **206** may include additional icons or symbols as known (not shown). First screen section **210** displays a cropped FOV_{UW} (and can be therefore called "UW screen section **210**") while second screen section **212** displays the Macro FOV_M (and can be therefore called "Macro screen section **212**"). Inside first section **210**, FOV_M **204** can be marked by a physical (i.e. visible on the screen) rectangle **204'**. Rectangle **204'** indicates the actual position of FOV_M **204** with respect to FOV_{UW} **202**. Optionally, another physical rectangle **204"** indicates a UW preview of OOI (flower) **208** in order to guide a user towards flower **208**. The user can see the position of FOV_M **204** relative to rectangle **204"** at all times in UW screen section **210**, while at the same time, Macro screen section **212** exhibits the scene within FOV_M. In use, the user moves the smartphone with camera towards flower **208**. In Macro screen section **212**, an arrow **218** indicates the direction and distance of movement required

to align flower **208** with Macro FOV_M **204**. In some examples, image data from UW FOV **202** may be displayed in Macro screen section **212**. This is for example beneficial when the Macro camera may not be in focus over entire camera FOV_M **204** or when there are other optical or image quality issues.

FIG. 2B, 2C show the process of moving the smartphone (and the FOV_M) towards flower **208** (i.e. toward preview **216**). In FIG. 2B, the UW screen section indicates that the movement of FOV_M **204** brings it close to rectangle **204"** (preview **216**). The flower starts to appear in Macro screen section **212**. In FIG. 2C, FOV_M **204** is seen in the UW screen section as fully overlapping rectangle **204"**, while flower **208** is displayed fully in Macro screen section **212**.

FIG. 3 illustrates an embodiment numbered **300** of a smartphone having a UW camera with a FOV_{UW} **302** and a Macro camera with a FOV_M **304** and a screen **306** according to presently disclosed subject matter. Screen **306** is split into a UW screen section **310** and a Macro screen section **312**, both in portrait orientation, i.e. first screen section and second screen section are split horizontally, beneficial when device is held in portrait orientation. As in FIG. 2C, inside first section **310**, FOV_M **304** is marked by a physical rectangle **304'**, and, optionally, another physical rectangle **304"** indicates a UW preview of a flower **308** (which forms an image **316** in a camera) in order to guide the user towards flower **308**.

Such a method or apparatus in which the screen is split and both the ultra-wide FOV and Macro FOV are shown allows the user to find an OOI and capture it with the Macro camera (and possibly also simultaneously with the UW camera) even if the handset (image capture device) occludes the OOI.

FIG. 4 shows in a flow chart of a method of use of a split screen for Macro-photography in a mobile electronic device, according to embodiments disclosed herein. In step **400**, a screen of a mobile electronic device is split to display both a non-Macro (e.g. UW) camera image stream (or cropped version of it) and a Macro camera image stream (or cropped version of it) simultaneously. In step **402**, an OOI/ROI as a scene for the Macro image is selected in the FOV_{UW} of the UW camera by a dedicated algorithm running on OOI/ROI selector **546** or by a human user. FOV_{UW} and FOV_M are calibrated. As known in the art, the position of the OOI/ROI in FOV_{UW} can be translated to a respective OOI/ROI position in FOV_M. In step **404,** the respective position of the OOI/ROI with respect to FOV_M is calculated based on the OOI/ROI location position in FOV_{UW}. In step **406**, the user is visually or otherwise guided towards the OOI/ROI's location position with

respect to the FOV_M. The visual or otherwise indication for the guiding may be visual (e.g. by arrow **218** shown in FIGS. 2A-B) or via a dedicated sound or via some haptic feedback. In some examples, user control unit **544** is configured to provide visual or otherwise indication. According to the guiding of step **406**, the user moves the camera's hosting device (e.g. smartphone) until the OOI/ROI appears in FOV_M. In step **408**, the user captures a Macro image (also referred to as "Super Macro image") of the OOI/ROI.

FIG. 5 shows schematically an embodiment of an electronic device (e.g. a smartphone) numbered **500** that includes a multi-camera and is configured to perform methods disclosed herein. Electronic device **500** comprises a Macro camera **510** with FOV_M. Macro camera **510** includes a Macro lens module **512** with a Macro lens, a Macro image sensor **514** and a lens actuator **516** for actuating Macro lens module **512**. The Macro lens forms a Macro image recorded by Macro image sensor **514**.

Optionally, the Macro lens may have a fixed effective focal length (EFL) providing a fixed zoom factor (ZF), or an adaptable (variable) EFL providing an adaptable ZF. The adaption of EFL may be discrete or continuous, i.e. a discrete number of varying EFLs for providing a plurality of discrete or continuous zoom states with respective ZFs. Camera **510** may be switched to a beneficial zoom state automatically**.**

Optionally, Macro camera **510** may be a folded camera that includes an OPFE **518** and an OPFE actuator **522** for actuating OPFE **518** for OIS and/or FOV scanning**.** In some embodiments, the FOV scanning of the Macro camera may be performed by actuating one or more OPFEs. A scanning Macro camera that performs FOV scanning by actuating two OPFEs is described for example in the co-owned US provisional patent application No. 63/110,057 filed November 5, 2020.

Macro camera module **510** further comprises a first memory **524**, e.g. in an EEPROM (electrically erasable programmable read only memory). In some embodiments, first calibration data may be stored in memory **524**. In other embodiments, the first calibration data may be stored in a third memory **560** such as a NVM (non-volatile memory). The first calibration data may comprise calibration data between image sensors **514** and **534**.

Electronic device **500** further comprises a UW camera **530** with a FOV_{UW} larger than FOV_M of camera **510.** UW camera **530** includes UW lens module **532** with a UW lens and a UW image sensor **534**. A lens actuator **536** may move lens module **532** for focusing and/or OIS. In some

embodiments, second calibration data may be stored in a second memory **538**. In other embodiments, the second calibration data may be stored in third memory **560**. The second calibration data may comprise calibration data between image sensors **514** and **534**.

The Macro camera may have an effective focal length (EFL) of e.g. 8 - 30mm or more, a diagonal FOV of 10 - 40deg and a f number of about f/# = 1.8 - 6. The UW camera may have an EFL of e.g. 2.5 - 8mm, a diagonal FOV of 50 -130deg and a f/# of about 1.0 – 2.5.

In some embodiments, the Macro camera may cover about 50% of the area of the UW camera's FOV. In some embodiments, the Macro camera may cover about 10% or less of the area of the UW camera's FOV.

Electronic device **500** further comprises an application processor (AP) **540**. Application processor **540** comprises a camera controller **542**, a user control unit **544**, OOI/ROI selector **546** and an image processor **548**. Electronic device **500** further comprises a screen control **550** and a screen **570**. Screen **570** may display methods as disclosed herein.

Returning now to the method of use as in FIG. 4, in some examples, the UW or W camera image data may be used by camera controller **542** to automatically change a state of the Macro camera (i.e. control a change of scan state of the Macro camera). The state may be a scan (or steer) state, a zoom state or a focus state. For example, UW or W camera image data may be used to steer (or scan) the FOV_M of a scanning Tele camera automatically towards a ROI (change of scan state of the Macro camera). In an example, the Macro camera can steer itself, and step **406** of guiding FOV_M to the ROI can be done automatically by camera control **542**. As indicated above, the selection of an OOI/ROI in the FOV_{UW} as a scene for the Macro image camera may be done by a dedicated algorithm running on OOI/ROI selector **546.** In another example, the Macro camera may use UW or W image data to switch between zoom states. Camera controller **542** may switch the Macro camera to a beneficial zoom state automatically (i.e. control a change of zoom state of the Macro camera), e.g. while executing steps **404** and **406**. A beneficial zoom state may be a state where a Macro OOI or ROI fully enters FOV_M. In yet another example, the W or UW camera's image data may be used by camera controller **542** to focus the Macro camera to a ROI within FOV_M automatically (i.e. control a change of focus state of the Macro camera). An OOI or ROI spanning a segment of a scene which is larger than FOV_M may be fully captured in two or more sequential frames wherein each frame includes a different segment of the OOI or ROI. The

sequential frames together include image data on the OOI or ROI in its entirety and are stitched to a single image by image processor **548**.

While this disclosure has been described in terms of certain examples and generally associated methods, alterations and permutations of the examples and methods will be apparent to those skilled in the art. The disclosure is to be understood as not limited by the specific examples described herein, but only by the scope of the appended claims.

It is appreciated that certain features of the presently disclosed subject matter, which are, for clarity, described in the context of separate examples, may also be provided in combination in a single example. Conversely, various features of the presently disclosed subject matter, which are, for brevity, described in the context of a single example, may also be provided separately or in any suitable sub-combination.

Unless otherwise stated, the use of the expression “and/or” between the last two members of a list of options for selection indicates that a selection of one or more of the listed options is appropriate and may be made.

It should be understood that where the claims or specification refer to "a" or "an" element, such reference is not to be construed as there being only one of that element.

All patents and patent applications mentioned in this specification are herein incorporated in their entirety by reference into the specification, to the same extent as if each individual patent or patent application was specifically and individually indicated to be incorporated herein by reference. In addition, citation or identification of any reference in this application shall not be construed as an admission that such reference is available as prior art to the present disclosure.

WHAT IS CLAIMED IS:

1. A mobile electronic device, comprising:

a first camera with a first field of view FOV_1;

a second, Macro camera with a Macro field of view FOV_M smaller than FOV_1; and

a device screen that includes a first screen section configured to display first image data from the first camera and a second screen section configured to display second image data from the Macro camera when both cameras are focused to a distance equal to or smaller than 30cm.

2. The mobile electronic device of claim 1, wherein the FOV_M is shown and marked within the first screen section.

3. The mobile electronic device of claim 1, wherein the first screen section includes a visual indication for guiding a user of the mobile electronic device towards a scene using the FOV_M.

4. The mobile electronic device of claim 1, wherein the second screen section displays first image data from the first camera.

5. The mobile electronic device of claim 1, further comprising a controller for controlling a change in state of the Macro camera based on the first image data.

6. The mobile electronic device of claim 1, wherein the first camera has a focal length between 2 and 7mm.

7. The mobile electronic device of claim 1, wherein the Macro camera has a focal length between 12 and 40mm.

8. The mobile electronic device of claim 1, wherein the Macro camera has a focal length between 14 and 30mm.

9. The mobile electronic device of claim 1, wherein the Macro camera has a focal length between 15 and 20mm.

10. The mobile electronic device of any of the claims 1-9, wherein both cameras can be focussed to a distance smaller than 20cm.

11. The mobile electronic device of any of the claims 1-9, wherein at least one camera can be focused to a distance between 5 and 10cm.

12. The mobile electronic device of any of the claims 1-9, wherein both cameras can be focused to a distance of 10cm or less.

13. The mobile electronic device of any of the claims 1-9, wherein at least one camera can be focused to a distance of 5cm or less.

14. The mobile electronic device of any of the claims 1-9, wherein at least one camera can be focused to a distance of 3cm or less.

15. The mobile electronic device of claim 1, wherein the first camera is an Ultra-Wide camera.

16. The mobile electronic device of claim 1, wherein the first camera is a Wide camera.

17. The mobile electronic device of claim 1, wherein the Macro camera is a scanning Tele camera.

18. The mobile electronic device of claim 1, wherein the Macro camera is a Tele camera having different zoom states.

19. The mobile electronic device of claim 1, wherein the first camera is focused to a first distance different from a second distance that the Macro camera is focused to.

20. The mobile electronic device of claim 1, wherein the first screen section and the second screen section are split vertically when the mobile electronic device is held in a landscape orientation, and wherein the first screen section and the second screen section are split horizontally when the mobile electronic device is held in a portrait orientation.

21. The mobile electronic device of claim 1, wherein the device is a smartphone.

22. The mobile electronic device of claim 5, wherein the state of the Macro camera is a zoom state.

23. The mobile electronic device of claim 5, wherein the state of the Macro camera is a focus state.

24. The mobile electronic device of claim 17, further comprising a controller for controlling a change of a scan state of the Macro camera based on the first image data.

25. A method, comprising:

providing a mobile electronic device that includes a first camera with a first field of view FOV_1, a second, Macro camera with a Macro field of view FOV_M smaller than FOV_1, and a device screen;

focusing the first camera and the Macro camera to a distance $\leq$ 30cm; and

displaying on a first section of the device screen first image data from the first camera and displaying on a second section of the device screen second image data from the second camera.

26. The method of claim 25, further comprising showing and marking the FOV_M within the first screen section.

27. The method of claim 25, further comprising including in the first screen section a visual indication for guiding a user of the mobile electronic device towards a scene using the FOV_M.

28. The method of claim 25, further comprising displaying the first image data in the second screen section.

29. The method of claim 25, wherein the first camera has a focal length between 2 and 7mm.

30. The method of claim 25, wherein the Macro camera has a focal length between 12 and 40mm.

31. The method of claim 25, wherein the focusing of the first camera and of the Macro camera to a distance ≤ 30cm includes focusing the first camera to a first distance ≤ 30cm and focusing the Macro camera to a distance ≤ 30cm different from the first distance.

32. The method of claim 25, wherein the focusing of the first camera and of the Macro camera to a distance ≤ 30cm includes focusing both cameras to a distance of 20cm or less.

33. The method of claim 25, wherein the focusing of the first camera and of the Macro camera to a distance ≤ 30cm includes focusing both cameras to a distance of 10cm or less.

34. The method of claim 25, wherein the focusing of the first camera and of the Macro camera to a distance ≤ 30cm includes focusing both cameras or one of the cameras to a distance of 5cm or less.

35. The method of claim 25, wherein the focusing of the first camera and of the Macro camera to a distance ≤ 30cm includes focusing both cameras or one of the cameras to a distance of 3cm or less.

36. The method of claim 25, further comprising controlling a change in state of the Macro camera based on the first image data.

37. The method of claim 36, wherein the controlling a change in state of the Macro camera includes controlling a change of a state selected from the group consisting of a scan state, a zoom state and a focus state of the Macro camera.

38. The method of claim 36, wherein the Macro camera is a scanning Tele camera and wherein the controlling a change in state of the Macro camera based on the first image data includes automatically controlling a change of a scan state of the scanning Tele camera.

39. The method of claim 36, wherein the Macro camera is a Tele camera having different zoom states and wherein the controlling a change in state of the Macro camera includes automatically controlling a change of a zoom state of the Tele camera.

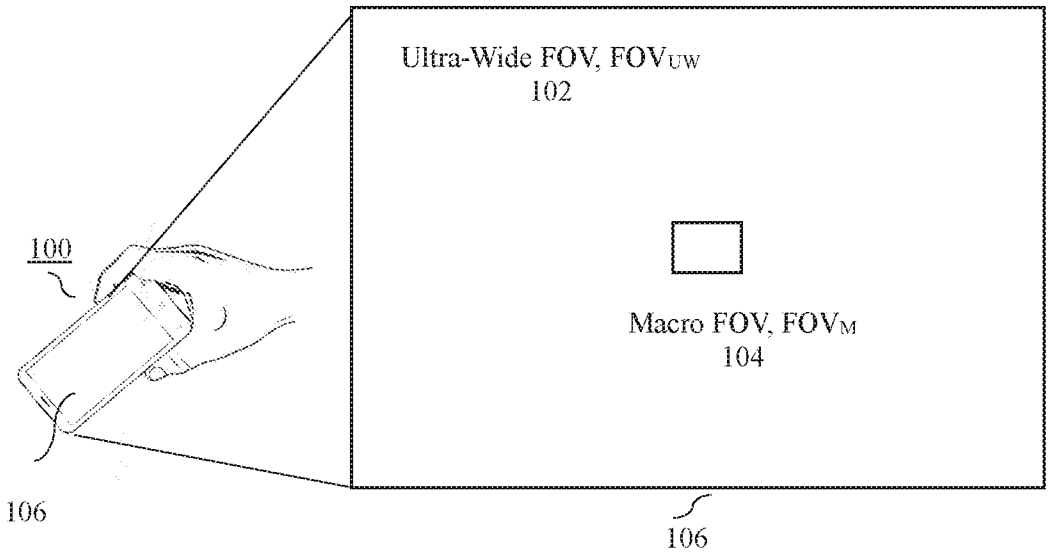


FIG. 1

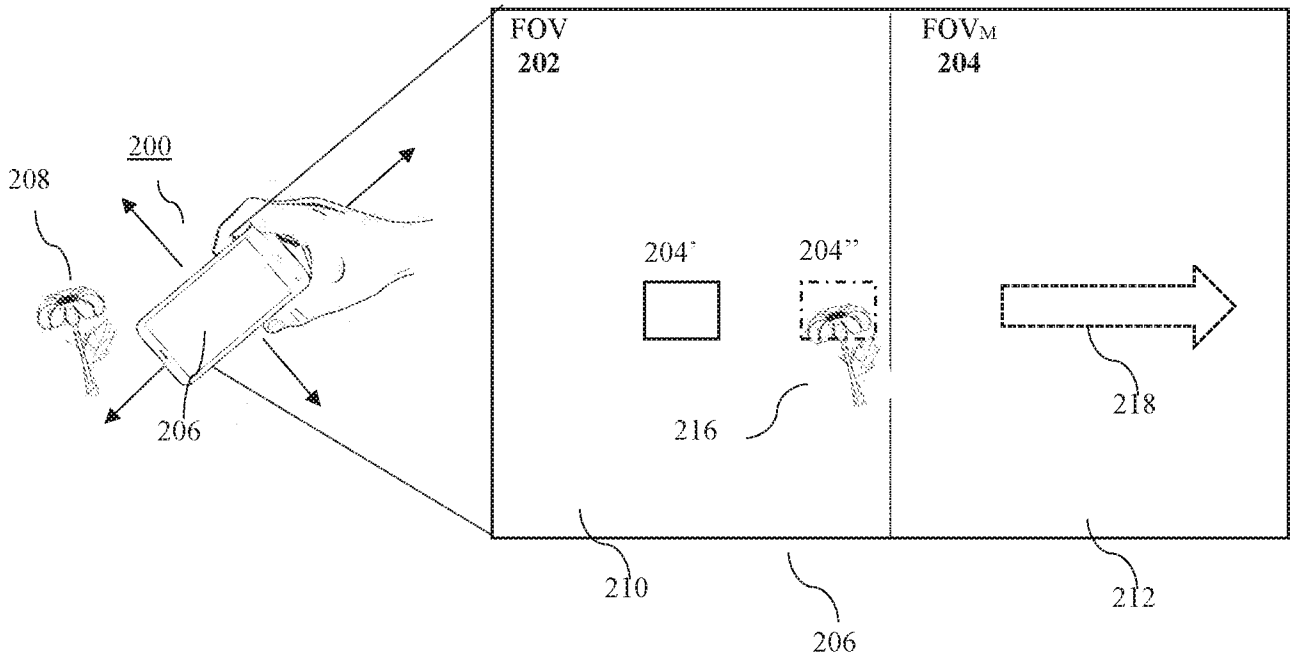

FOV
202
FOVM
204
200
208
204'
204"
216
218
206
210
206
212

FIG. 2A

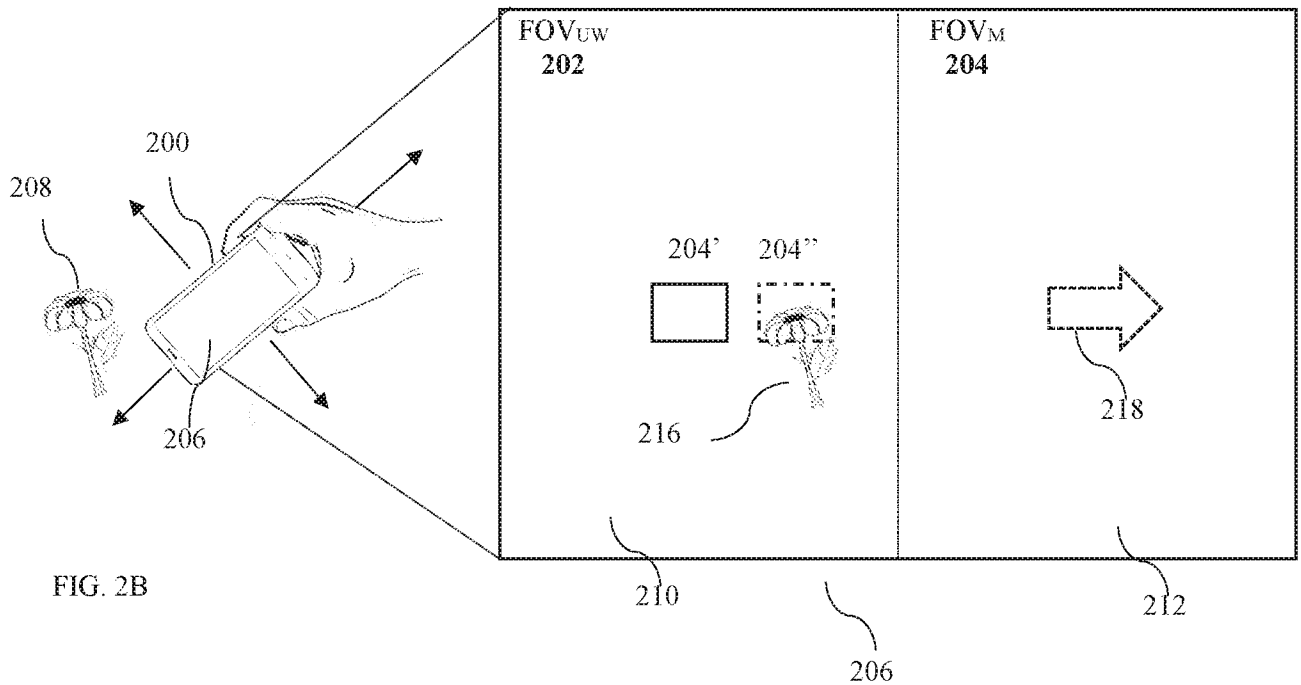

FOVUW
202
FOVM
204
200
208
204'
204"
216
218
206
210
206
212

FIG. 2B

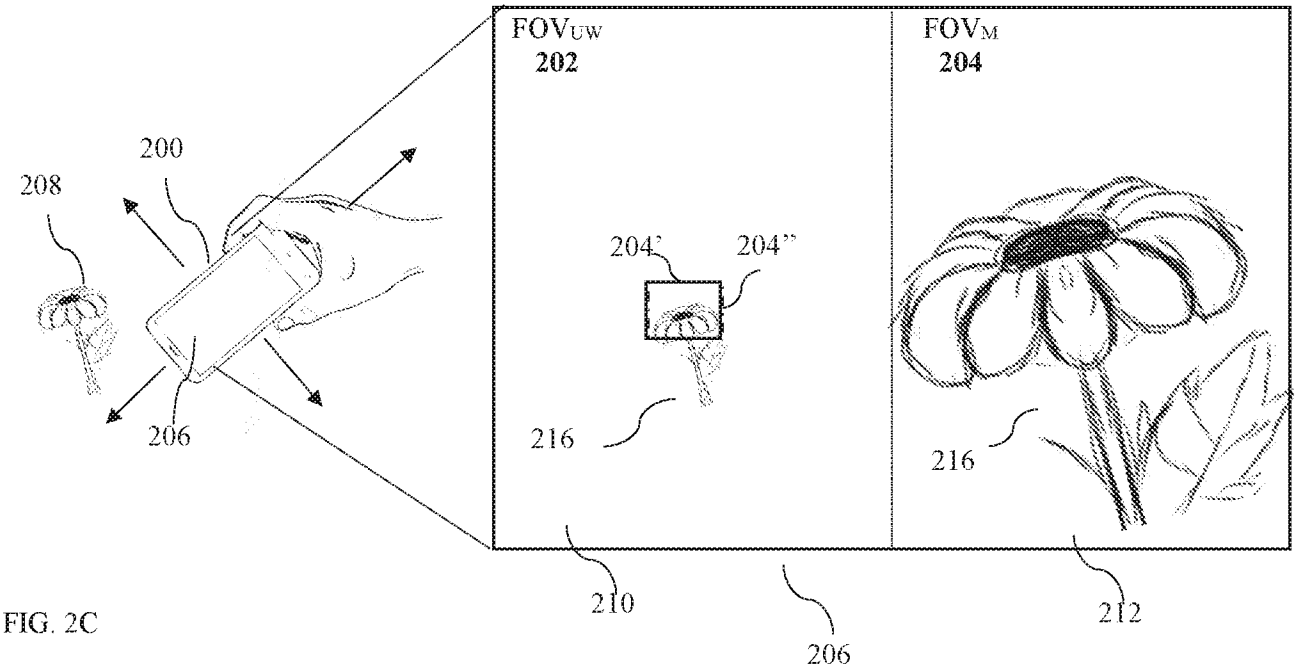

FOVUW
202
FOVM
204
200
208
204'
204"
216
206
216
210
206
212

FIG. 2C

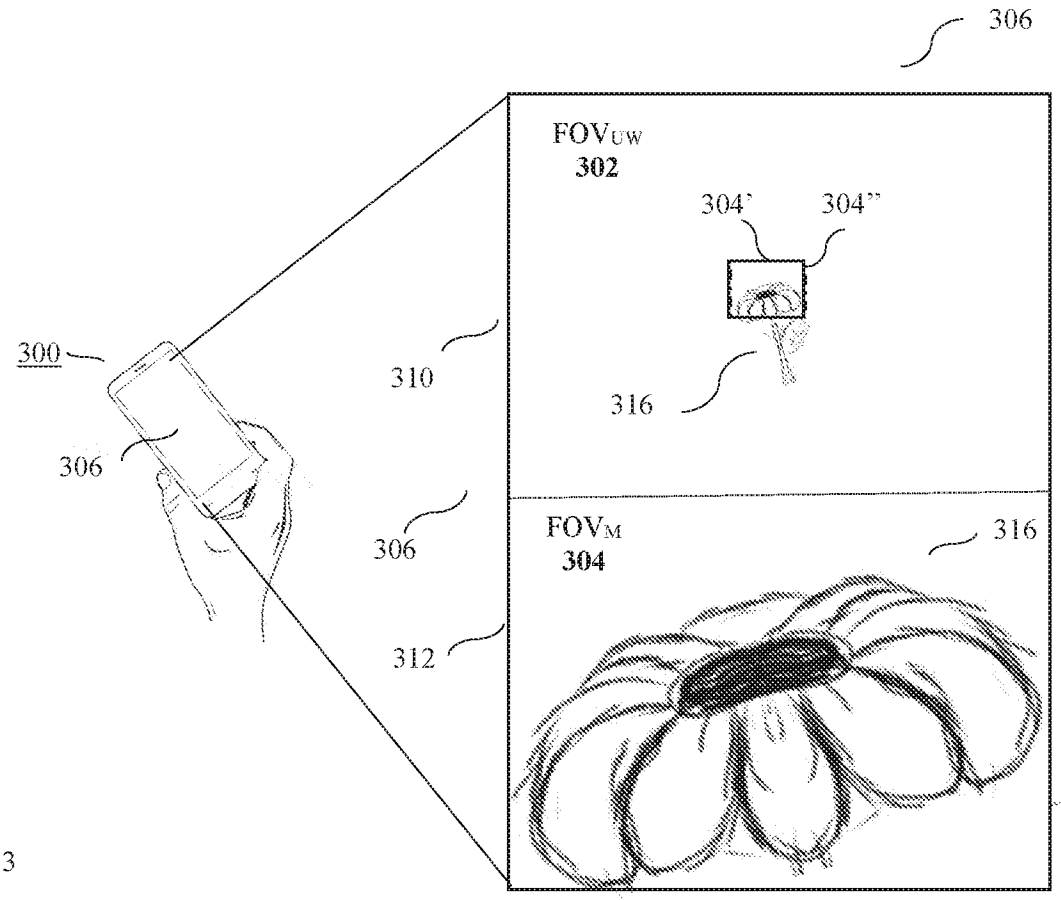

306
FOVUW
302
304'
304"
300
310
316
306
306
FOVM
304
316
312

FIG. 3

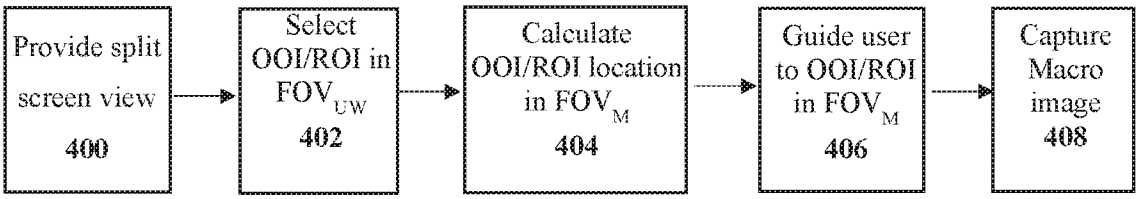

Provide split screen view 400
Select OOI/ROI in FOV_{UW} 402
Calculate OOI/ROI location in FOV_{M} 404
Guide user to OOI/ROI in FOV_{M} 406
Capture Macro image 408

FIG. 4

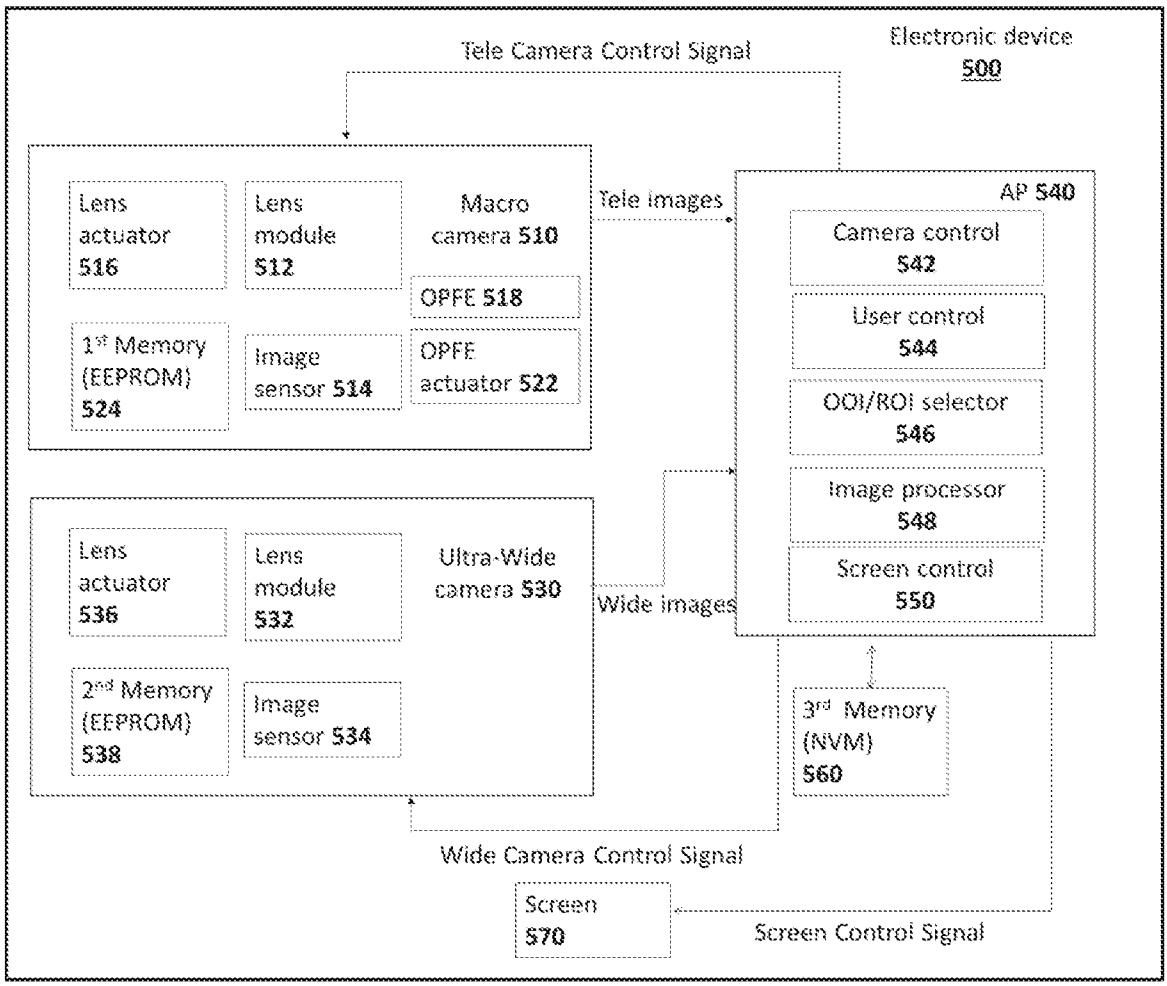

Tele Camera Control Signal
Electronic device 500
Lens actuator 516
Lens module 512
Macro camera 510
OPFE 518
1st Memory (EEPROM) 524
Image sensor 514
OPFE actuator 522
Tele images
AP 540
Camera control 542
User control 544
OOI/ROI selector 546
Image processor 548
Screen control 550
Lens actuator 536
Lens module 532
Ultra-Wide camera 530
Wide images
2nd Memory (EEPROM) 538
Image sensor 534
3rd Memory (NVM) 560
Wide Camera Control Signal
Screen 570
Screen Control Signal

FIG. 5

INTERNATIONAL SEARCH REPORT

International application No.
PCT/IB21/50639

A. CLASSIFICATION OF SUBJECT MATTER

IPC - G06K 9/00; G03B 30/00; G02B 13/00 (2021.01)

CPC - G02B 13/001; G03B 30/00; G02B 13/009; H04N 5/23212; G06K 9/00134; G03B 2205/0046

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)
See Search History document

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

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

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	US 2016/0381289 A1 (SAMSUNG ELECTRONICS CO., LTD.) 29 December 2016 (29.12.2016); figs 1, 11; paras [0089], [0093], [0094], [0137], [0192].	1-39
Y	US 2018/0368656 A1 (CAMPLEX, INC.) 27 December 2018 (27.12.2018); paras [1285], [1613].	1-39
Y	US 2009/0190909 A1 (MISE et al.) 30 July 2009 (30.07.2009); paras [0036], [0050], [0052], [0065], [0080].	17, 24, 38

☐ Further documents are listed in the continuation of Box C. ☐ 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
"D" document cited by the applicant in the international application
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"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
07 May 2021 (07.05.2021)	JUN 09 2021
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