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(54) DEVICE, SYSTEM, AND METHOD FOR IN-VIVO SENSING OF A SUBSTANCE

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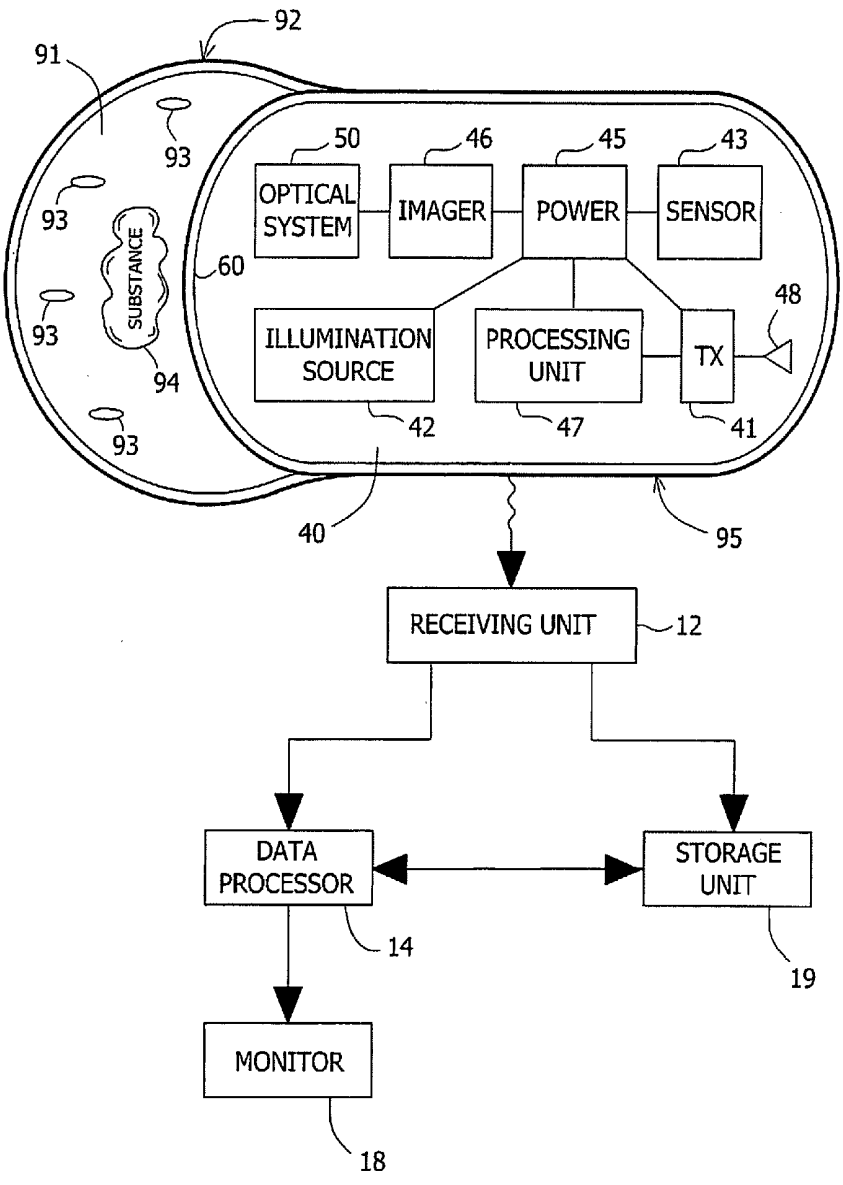
(57) **ABSTRACT**

An in vivo device and a method for imaging, monitoring and/or sensing of a substance in a body lumen. The in vivo device may include a holding unit, for example a cap for holding the substance, and sensing means, for example a sensor, an imager and an illumination source, for capturing various information in relation to the changes occurring in the substance.



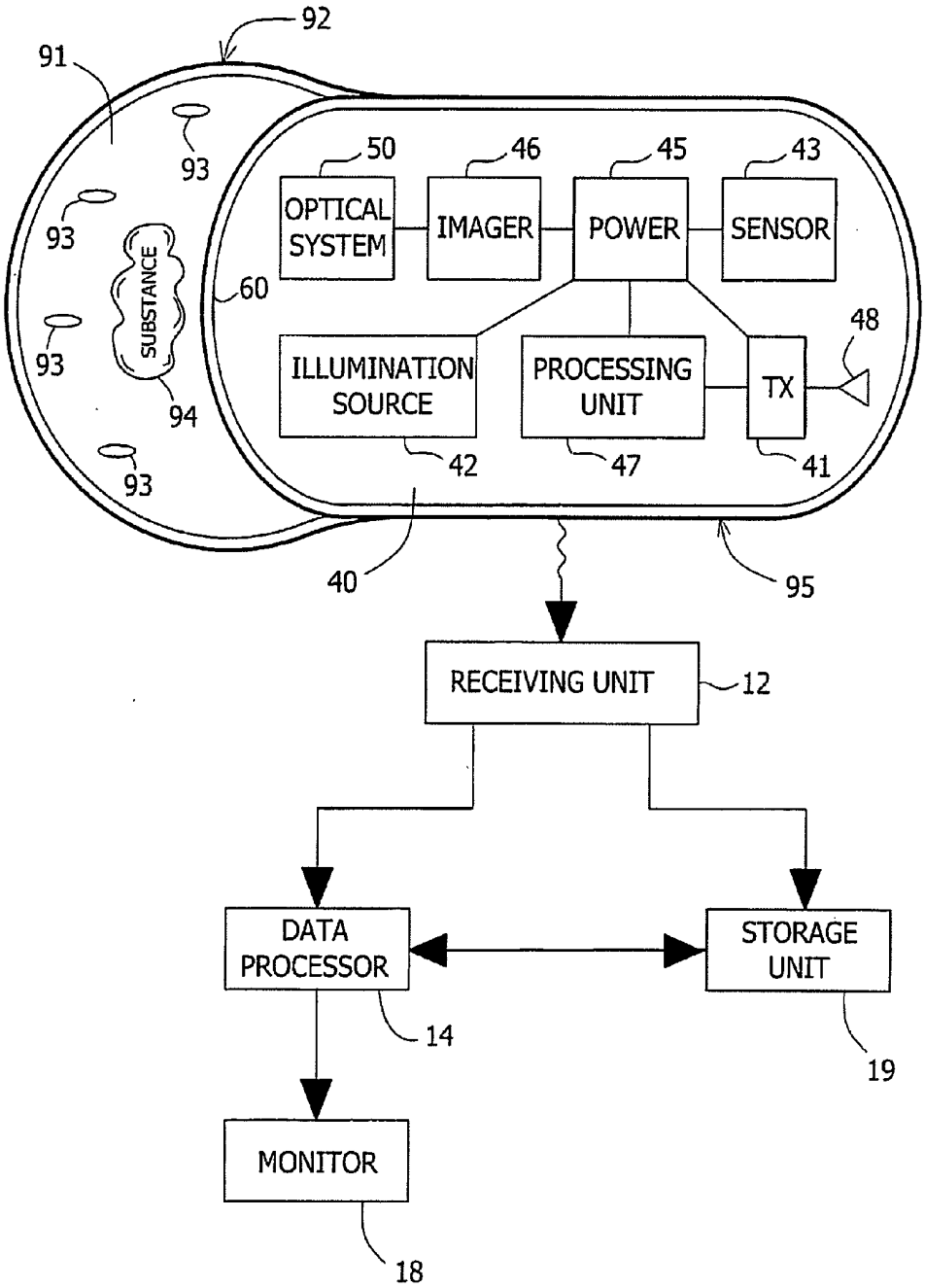

92
91
93
93
93
93
SUBSTANCE
94
50
46
45
43
OPTICAL SYSTEM
IMAGER
POWER
SENSOR
60
48
ILLUMINATION SOURCE
PROCESSING UNIT
TX
42
47
41
40
95
RECEIVING UNIT
12
DATA PROCESSOR
STORAGE UNIT
14
19
MONITOR
18

Fig. 1

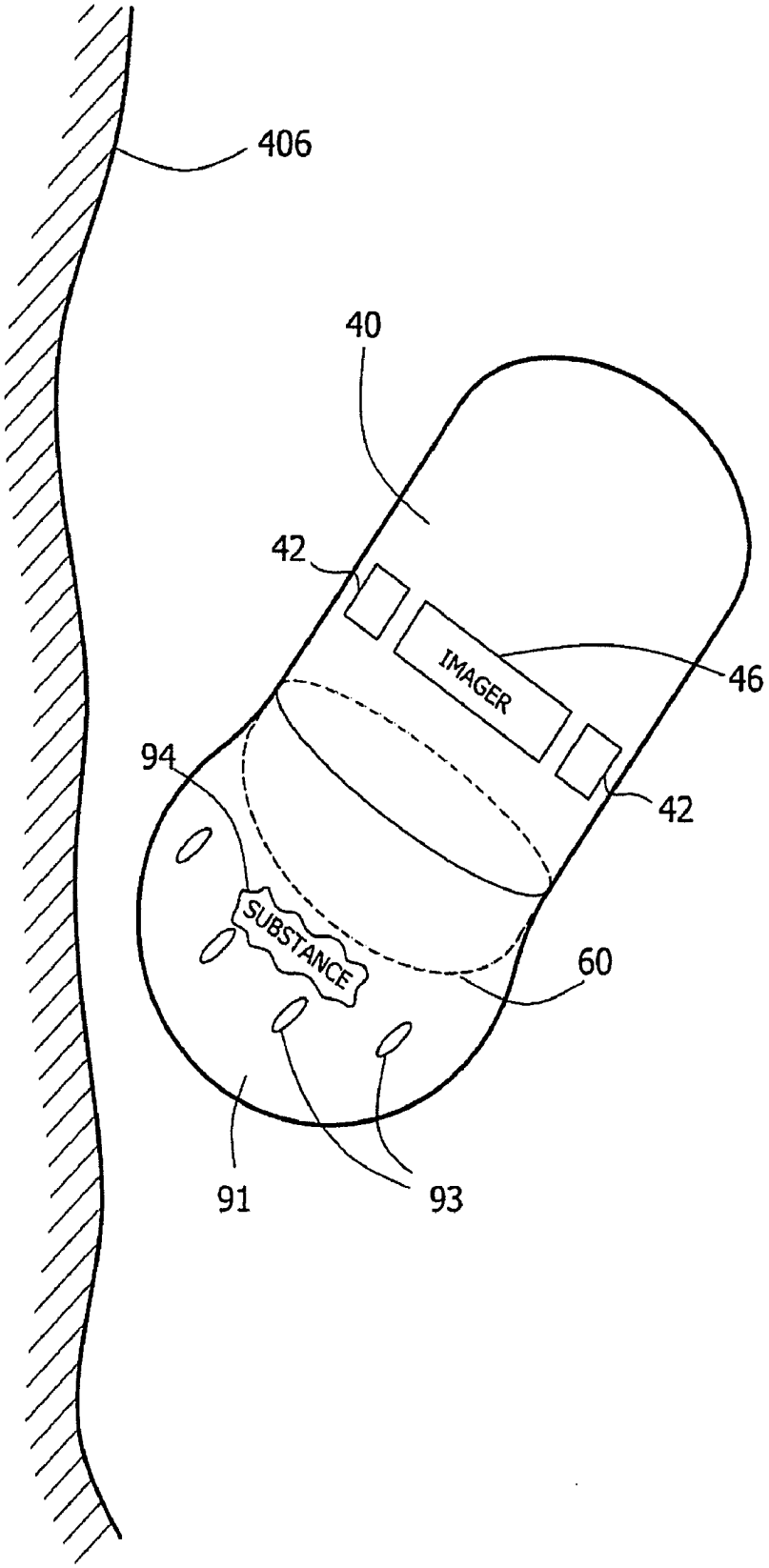


Fig. 2

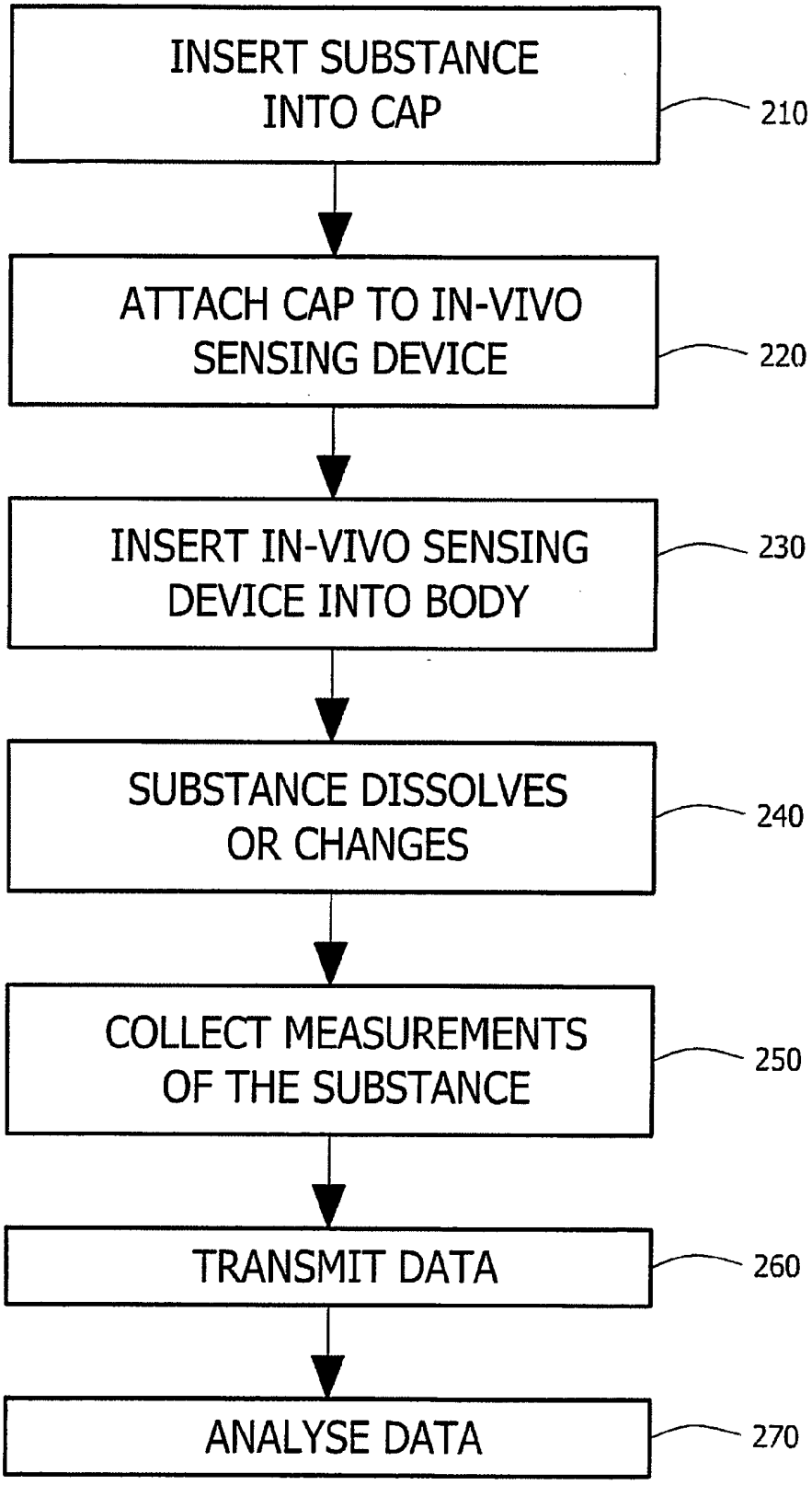

INSERT SUBSTANCE INTO CAP
210
ATTACH CAP TO IN-VIVO SENSING DEVICE
220
INSERT IN-VIVO SENSING DEVICE INTO BODY
230
SUBSTANCE DISSOLVES OR CHANGES
240
COLLECT MEASUREMENTS OF THE SUBSTANCE
250
TRANSMIT DATA
260
ANALYSE DATA
270

Fig. 3

DEVICE, SYSTEM, AND METHOD FOR IN-VIVO SENSING OF A SUBSTANCE

RELATED APPLICATION DATA

[0001] This application claims benefit from U.S. provisional application Ser. No. 60/530,246, filed on Dec. 18, 2003, entitled DEVICE, SYSTEM, AND METHOD FOR IN-VIVO SENSING OF A SUBSTANCE which is incorporated in its entirety by reference.

FIELD OF THE INVENTION

[0002] The present invention relates to the field of in-vivo sensing. More specifically, the present invention relates to devices, systems, and methods for in-vivo sensing, monitoring or imaging of a substance.

BACKGROUND OF THE INVENTION

[0003] Devices, systems and methods for in-vivo sensing of passages or cavities within a body, and for gathering information (e.g., image information, pH information, temperature information, electrical impedance information, pressure information, etc.), are known in the art.

[0004] An in-vivo sensing device may include, for example, an imaging device for obtaining images from inside a body cavity or lumen, such as the gastrointestinal (GI) tract. The imaging device may include, for example, an imager associated with units such as, for example, an optical system, an illumination source, a power source, a transmitter and an antenna. Other types of in-vivo sensing devices exist, such as endoscopes which may not require a transmitter, and devices performing functions other than imaging.

[0005] A substance (e.g., a drug, a food, a chemical substance, etc.) may be inserted into a patient's body, and may dissolve or otherwise change one or more of its properties while in the GI tract. Typically, known in vivo sensing devices can not monitor a change in a substance while in the GI tract or in other body lumens.

[0006] There is therefore a need for a device, system and method for capturing information of a substance within lumens or cavities or in other locations within the body.

SUMMARY OF THE INVENTION

[0007] There is provided, in accordance with some embodiments of the present invention, a device, system, and method for sensing, monitoring and/or imaging of a substance in-vivo and/or in-vitro. According to one embodiment of the invention there may be provided, in an in vivo device one or more sensors, a holding unit or compartment such as formed by a basket or a cap which may hold a substance, for example a drug, a food or a chemical matter which may dissolve when placed in a digestive system of a human body or in a specific part of the digestive system, e.g., in the stomach, in the large intestine or in other parts.

[0008] According to one embodiment the in vivo device may sense, image, monitor and/or otherwise capture various information or properties in relation to the dissolving of the substance, for example images of the substance as it dissolves, temperature, pH level etc. The information may be analyzed by a data processor which may produce conclusions related to the dissolving or changing of the substance.

[0009] Embodiments of the invention may allow various other benefits, and may be used in conjunction with various other applications.

BRIEF DESCRIPTION OF THE DRAWINGS

[0010] The subject matter regarded as the invention is particularly pointed out and distinctly claimed in the concluding portion of the specification. The invention, however, both as to organization and method of operation, together with objects, features and advantages thereof, may best be understood by reference to the following detailed description when read with the accompanied drawings in which:

[0011] **FIG. 1** is a schematic illustration of an in-vivo sensing system in accordance with an embodiment of the invention;

[0012] **FIG. 2** is a schematic illustration of an in-vivo sensing device in accordance with an embodiment of the invention; and

[0013] **FIG. 3** is a flow-chart diagram of a method of in-vivo sensing in accordance with an embodiment of the invention.

[0014] It will be appreciated that for simplicity and clarity of illustration, elements shown in the figures have not necessarily been drawn to scale. For example, the dimensions of some of the elements may be exaggerated relative to other elements for clarity. Further, where considered appropriate, reference numerals may be repeated among the figures to indicate corresponding or analogous elements.

DETAILED DESCRIPTION OF THE INVENTION

[0015] In the following description, various aspects of the invention will be described. For purposes of explanation, specific configurations and details are set forth in order to provide a thorough understanding of the invention. However, it will also be apparent to one skilled in the art that the invention may be practiced without the specific details presented herein. Furthermore, well known features may be omitted or simplified in order not to obscure the invention.

[0016] It should be noted that although a portion of the discussion may relate to in-vivo imaging devices, systems, and methods, the present invention is not limited in this regard, and embodiments of the present invention may be used in conjunction with various other in-vivo sensing devices, systems, and methods. For example, some embodiments of the invention may be used, for example, in conjunction with in-vivo sensing of pH, in-vivo sensing of temperature, in-vivo sensing of pressure, in-vivo sensing of electrical impedance, in-vivo detection of a substance or a material, in-vivo detection of a medical condition or a pathology, in-vivo acquisition or analysis of data, and/or various other in-vivo sensing devices, systems, and methods.

[0017] Some embodiments of the present invention are directed to a typically swallowable in-vivo sensing device. Devices according to embodiments of the present invention may be similar to embodiments described in International Application WO 01/65995 entitled A DEVICE AND SYSTEM FOR IN-VIVO IMAGING and/or in U.S. Pat. No. 5,604,531 entitled IN-VIVO VIDEO CAMERA SYSTEM,

each of which are assigned to the common assignee of the present invention and each of which are hereby incorporated by reference. Furthermore, a receiving and/or display system which may be suitable for use with embodiments of the present invention may also be similar to embodiments described in WO 01/65995 and/or in U.S. Pat. No. 5,604,531. Of course, devices and systems as described herein may have other configurations and/or other sets of components. For example, the present invention may be practiced using an endoscope, needle, stent, catheter etc.

[0018] **FIG. 1** shows a schematic diagram of an in-vivo and/or in-vitro sensing system in accordance with an embodiment of the present invention. In one embodiment, the system may include a device **40** having an imager **46**, one or more illumination source(s) **42**, and a transmitter **41**. In some embodiments, device **40** may be implemented using a swallowable capsule, but other sorts of devices or suitable implementations may be used. Device **40** may communicate with an external receiving and display system to provide display of data, control, or other functions. For example, power may be provided by an internal battery or a wireless receiving system. Other embodiments may have other configurations and capabilities. For example, outside a patient's body may be a receiving unit, for example, a receiving unit **12** (including, for example, an antenna or an antenna array), a storage unit **19**, a data processor **14**, and an output device, such as a monitor **18** or other suitable data displaying apparatus, which may display output data, such as image data or other data. Device **40** may include a container or holding unit, such as basket or cap **91**, holding a possibly dissolvable substance **94**. A transparent or partially transparent portion **60** may separate components of device **40** such as imager **46**, which may be sealed within shell **95**, and cap **91**, which may be open to the outside environment e.g., letting fluids in. Transparent portion **60** may be integral with shell **95**, or may be a separate piece.

[0019] Monitor **18** may include, for example, one or more screens, monitors, or suitable display units. Monitor **18**, for example, may display images captured and/or transmitted by device **40**, control data, position data (e.g., data describing or indicating the location or the relative location of device **40**), and various other suitable data. In some embodiments, for example, monitor **18** may display images of a substance, a dissolving substance or a changing substance (e.g., substance **94** described herein), or data related to such substances. In one embodiment, for example, both an image and its position or location may be presented using a single monitor, or using a plurality of monitors. Other systems and methods of storing and/or displaying collected image data may be used. In addition, components may be distributed over multiple sites or units.

[0020] Transmitter **41** may be a wireless transmitter, e.g., operate wirelessly by using radio waves, IR or other known wireless transmission technologies; but in some embodiments, such as those where device **40** is or is included within an endoscope, transmitter **41** may transmit via, for example, wire optical fiber and/or other suitable methods.

[0021] Device **40** typically may be or may include an autonomous swallowable capsule, but device **40** may have other shapes and need not be swallowable or autonomous. Embodiments of device **40** are typically autonomous, and are typically self-contained. For example, device **40** may be a capsule or other unit where all the components are substantially contained within a container or shell, and where device **40** does not require any wires or cables to, for example, receive power or transmit information.

[0022] In one embodiment, device **40** may include an imager **46**, for example an in-vivo video camera, which may capture and transmit images of, for example, the GI tract while device **40** passes through the GI lumen. In other embodiments the imager need not capture images of the body, but may rather more or less exclusively image the substance **94**. Other lumens and/or body cavities may be imaged and/or sensed. In some embodiments, imager **46** may include, for example, a Charge Coupled Device (CCD) camera or imager, a Complementary Metal Oxide Semiconductor (CMOS) camera or imager, a digital camera, a still camera, or other suitable imagers, cameras, or image acquisition components.

[0023] In one embodiment, imager **46** in device **40** may be operationally connected to transmitter **41**. Transmitter **41** may transmit images to, for example, receiving unit **12**, which may send the data to data processor **14** and/or to storage unit **19**. Transmitter **41** may also include control capability, although control capability may be included in a separate component. Transmitter **41** may include any suitable transmitter able to transmit image data, other sensed data, and/or other data (e.g., control data) to a receiving device. For example, transmitter **41** may include an ultra low power Radio Frequency (RF) high bandwidth transmitter, possibly provided in Chip Scale Package (CSP). Transmitter **41** may transmit via antenna **48**. Optionally, transmitter **41** and/or device **40** may include a controller, which may include one or more control modules, circuitry and/or functionality for controlling device **40** and/or for controlling the operational mode or settings of device **40**.

[0024] Power source **45** may include one or more batteries. For example, power source **45** may include silver oxide batteries, lithium batteries, other suitable electrochemical cells having a high energy density, or the like. Other power sources may be used. For example, power source **45** may receive power or energy from an external power source (e.g., a power transmitter), which may be used to transmit power or energy to device **40**.

[0025] Data processor **14** may analyze the data received from device **40**, and may be in communication with storage unit **19**, transferring frame data to and from storage unit **19** Data processor **14** may also provide the analyzed data to monitor **18**, where a user (e.g., a physician, and/or a scientist) may view the data. Monitor **18** may display one or more images of the GI lumen (or of other imaged body lumen or cavity), and/or the position or location in the GI tract (or other body lumen or cavity) at which the image or images were taken. In some embodiments, for example, monitor **18** may display images of a substance, a dissolving substance or a changing substance (e.g., substance **94** described herein), or data related to such substances. In one embodiment, data processor **14** may be configured for real time processing and/or for post processing to be performed and/or viewed at a later time. In the case that control capability (e.g., delay, timing, etc) is external to device **40**, a suitable external device (such as, for example, data processor **14** or receiving unit **12**) may transmit one or more control signals to device **40**.

[0026] In some embodiments, in addition to or instead of revealing pathological or other conditions of the GI tract, the system may provide information about the location of these conditions, or about the location of a substance (e.g., a dissolving or changing substance). Suitable tracking devices and methods are described in embodiments of the above-mentioned U.S. Pat. No. 5,604,531 and/or U.S. Patent Application Publication No. U.S.-2002-0173718-A1, filed on May 20, 2002, titled "Array System and Method for Locating an In-Vivo Signal Source", assigned to the assignee of the present invention, and fully incorporated herein by reference. Other suitable location identification systems and methods may be used in accordance with embodiments of the present invention.

[0027] Optionally, device **40** may include a processing unit **47**, for example, to process signals and/or data generated by imager **46**. In some embodiments, processing unit **47** need not be a separate component; for example, processing unit **47** may be integral to imager **46**, to transmitter **41**, to another component, or may not be needed. In some embodiments processing may be done in a component that is external to the body.

[0028] In some embodiments, device **40** may include one or more illumination sources **42**, for example one or more white LEDs or any other suitable light sources. Illumination sources **42** may, for example, illuminate a body lumen being imaged and/or sensed. In some embodiments, for example, illumination sources **42** may, for example, illuminate a substance, a dissolving substance or a changing substance (e.g., substance **94** described herein). An optical system **50**, including, for example, one or more optical elements, such as one or more lenses or composite lens assemblies, one or more suitable optical filters, or any other suitable optical elements, may aid in focusing reflected light onto imager **46** and/or performing other light processing operations.

[0029] Typically, device **40** may transmit image information in discrete portions. Each portion may typically correspond to an image or a frame; other suitable transmission methods may be used. For example, in some embodiments, device **40** may capture and/or acquire an image once every half second, and may transmit the image data to receiver **12**. Other constant and/or variable capture rates and/or transmission rates may be used.

[0030] Typically, the image data recorded and transmitted may include digital color image data; in alternate embodiments, other image formats (e.g., black and white image data) may be used. In one embodiment, each frame of image data may include 256 rows, each row may include 256 pixels, and each pixel may include data for color and brightness according to known methods. For example, in each pixel, color may be represented by a mosaic of four sub-pixels, each sub-pixel corresponding to primaries such as red, green, or blue (where one primary is represented twice). The brightness of the overall pixel may be recorded by, for example, a one byte (e.g., 0-255) brightness value. Other suitable data formats may be used, and other suitable numbers or types of rows, pixels, sub-pixels and/or colors may be used.

[0031] Optionally, device **40** may include one or more sensors **43**, instead of or in addition to a sensor such as imager **46**. Sensor **43** may, for example, sense, detect, determine and/or measure one or more values of properties or characteristics of the surrounding of device **40** and/or of substance **94**. For example, sensor **43** may include a pH sensor, a temperature sensor, an electrical conductivity or impedance sensor, a pressure sensor, or any other known suitable in-vivo sensor. In some embodiments, sensor **43** may be placed, situated and/or positioned substantially adjacent to the outer wall or shell of device **40**, for example, so as to maximize or increase the exposure of sensor **43** to the in-vivo conditions outside of such wall of device **40**.

[0032] In some embodiments, components within device **40** may be connected and/or operatively connected, for example, using a wired or wireless connection. In one embodiment, optionally, some components within device **40** may be operatively connected to, or included or embedded within, an Application Specific Integrated Circuit (ASIC). In alternate embodiments, components within device **40** (e.g., imager **46**, or sensor **43**) may be operatively linked and/or connected to each other without an ASIC, for example, using a wired connection, a wireless connection, a microwave connection, or other suitable connections.

[0033] Device **40** may include a holding unit, basket or cap **91**. In one embodiment, holding unit, basket or cap **91** may include or may be, for example, a compartment, a head, a basket, a pod, a nodule, a bubble, a cover, a case, a casing, or another suitable container. Cap **91** may be external to device **40**, for example, cap **91** may be attached or otherwise bonded to a side of device **40**. In one embodiment, cap **91** may be located and/or positioned to be in proximity, or in relative proximity, to imager **46**, to optical system **50**, to illumination source **42**, or to a region of device **40** which includes one or more of these components. The imager **46** may be configured or aligned so that it may image at least part of the compartment or space formed by the cap **91**. Illumination source(s) **42** may be aligned so that at least a portion of the illumination given off is reflected by substance **94**. Typically, illumination source(s) **42** illuminate substance **94** via transparent portion **60**, and imager **46** may view substance **94** via transparent portion **60**. In some embodiments, cap **91** may be detachable from device **40**, for example so that substances may be inserted or taken out. For example, cap **91** may be attached to and detached from device **40**, e.g., using a pressure mechanism, a bonding mechanism, a holding mechanism, a screw thread mechanisms, one or more screws or holders, glue, soldering or other suitable mechanisms. In alternate embodiments, for example, cap **91** may be integrated with a shell **95** of device **40**, or cap **91** may be an integral and/or integrated part of shell **95** of device **40**. A door or latch may be provided on cap **91**, so that substances may be inserted or taken out.

[0034] In some embodiments, cap **91** may include a shell **92**. Shell **92** may include or may be, for example, a transparent, semi-transparent or non-transparent layer or cover; cap **91** may be transparent, semi-transparent or non-transparent. In some embodiments, shell **92** may include one or more holes or pores **93**. Holes or pores **93** may include various suitable outlets, gaps, slits, openings and/or punctures, which may have various suitable sizes and shapes. Although **FIG. 1** shows four circular holes **93**, other number of holes **93** may be used, and various other shapes of holes **93** (e.g., square, rectangular, oval, triangular, etc.) may be used; similarly, the location or relative positioning of holes **93** in shell **92** may be different from the example shown in **FIG. 1**.

[0035] In some embodiments, cap **91** and shell **92** may be formed of, for example, plastic, transparent or semi-transparent plastic, glass, plastic-glass, isoplast™, etc. In one embodiment, for example, cap **91** and/or shell **92** need not be transparent, and device **40** may sense and/or image a substance contained within cap **91**, shell **92** and/or device **40**.

[0036] In some embodiments, cap **91** may include or contain a substance **94**. Substance **94** may include, for example, a drug, a compound, a pharmaceutical drug or compound, a chemical substance, a test substance or drug, an experimental substance or drug, a food, a medicine, a medication, a dye, a pill, a tablet, a softgel, a sphere, a capsule, or a plurality of such materials. Substance **94** may include, for example, solid matter, liquid matter, blended or mixed matters, with various shapes, sizes, weights, colors or properties.

[0037] In some embodiments, substance **94** may dissolve, solidify, liquefy, turn into liquid or solid, soften, harden, change color, blend, mix, or otherwise change one or more of its properties when inserted into a body of a human being or other living being, or when inserted into a body organ, lumen or region of such a body of a human being or other living being. For example, in some embodiments, substance **94** may include a drug, a food or a chemical matter which may dissolve when placed in a digestive system of a human body or in a specific part of the digestive system, e.g., in the stomach, in the large intestine or in other parts.

[0038] In one embodiment, holes **93** may be sufficiently large to allow one or more body liquids (e.g. blood, digestive system fluids, etc.) to touch substance **94** and to affect, such to dissolve or further dissolve substance **94**. Holes **93** may be sufficiently large to allow such body liquids to enter into cap **91** and/or to exit cap **91**. In some embodiments, holes **93** may have properties (e.g., size, number, position, shape, etc.) to allow a graduate, slow or rapid dissolution of substance **93** into the body environment which surrounds device **40** or cap **91**. Typically, when initially inserted into cap **91**, substance **94** may be a block, pill or mass which cannot pass through holes **93**; this may change as dissolving or breaking apart occurs.

[0039] In some embodiments, substance **94** may dissolve, or gradually dissolve, into the body environment in which device **40** is located. Device **40** may sense, image, monitor and/or otherwise capture various information or properties in relation to the dissolving of substance **94**. For example, in some embodiments, device **40** may image (e.g., using imager **46**) and may capture images of substance **94** as it dissolves or otherwise changes its properties. In one embodiment, device **40** may monitor or capture other suitable information in relation to the dissolving of substance **94**, for example, temperature, pH level, pressure, position, dissolving speed, dissolving time, dissolving rate, dissolving pattern, properties of substance **94** as it dissolves (e.g., size, dimensions, shape, color, volume, etc.), or the like.

[0040] In one embodiment, imager **46** may image substance **94** as it dissolves and/or changes. In an alternate embodiment, imager **46** may image a body organ in which device **40** is located as substance **94** dissolves and/or changes. In another embodiment, imager **46** may image both substance **94** as it dissolves and/or changes, and the body organ in which device **40** is located; this may be performed, for example, using two or more imagers similar to imager **46**, or using an imager **46** and/or optical system **50**, which may be pointed, positioned and/or focused to allow capturing images of both substance **94** and the body organ in which device **40** is located.

[0041] In some embodiments, device **40** may capture images, data and/or information, which may indicate, or which may allow further processing or calculations to indicate, for example, various conclusions, results or data regarding the dissolving or changing of substance **94**. Such results may include, for example, that substance **94** dissolves or changes relatively slowly or relatively rapidly in a certain body organ (e.g., the small intestine, the large intestine, etc.); that substance **94** dissolves or changes faster or slower if substance **94** has or does not have certain properties (e.g., shape, size, weight, volume, etc.); that substance **94** dissolves well or does not dissolve well; or other suitable results.

[0042] It is noted that in some embodiments, device **40** may include other suitable components. For example, transparent portion **60** may be an optical dome. Device **40** may include other suitable types of domes, optical domes, or components.

[0043] Reference is now made to **FIG. 2**, which is a schematic illustration of an in-vivo sensing device in accordance with an embodiment of the invention. As shown in **FIG. 2**, device **40** may include, or may be attached to, cap **91**. Cap **91** may include holes or pores **93**. It is noted that device **40**, holes or pores **93**, and/or cap **91** may have various other suitable shapes, dimensions, sizes or proportions.

[0044] According to one embodiment, transparent portion **60** may include an optical dome. In one embodiment, the optical dome may typically be transparent; in an alternate embodiment, the optical dome may be semi-transparent. In some embodiments, the optical dome or the transparent portion **60** may be formed of, for example, plastic, transparent or semi-transparent plastic, glass, plastic-glass, isoplast™, etc. In some embodiments, optical dome or the transparent portion **60** may be used as a barrier between the components of device **40** and the contents of cap **91** (e.g., substance **94**).

[0045] Typically, the contents of cap **91** (e.g., substance **94**) may be illuminated (e.g., by illumination sources **42**) through the or the transparent portion **60** and an image of the contents of cap **91** may be formed on an imager positioned behind the or the transparent portion **60** (e.g., imager **46**).

[0046] According to one embodiment, an image may include in-vivo data and data relating to the contents of cap **91**. For example, cap **91** may be transparent such that illumination passing through or the transparent portion **60** may also pass through cap **91** illuminating both the contents of cap **91** and, for example, a body lumen wall **406**. Thus, an image formed may include data relating to the body lumen and/or to the contents of cap **91** in the body lumen.

[0047] **FIG. 3** is a flow-chart diagram of a method of in-vivo and/or in-vitro sensing in accordance with an embodiment of the present invention. The method of **FIG. 3**, as well as other suitable methods in accordance with embodiments of the invention, may be used, for example, in association with the system of **FIG. 1**, with one or more in-vivo sensing devices (which may be, but need not be, similar to device **40**), and/or with other suitable devices and systems for in-vivo sensing.

[0048] In some embodiments, as indicated at block **210**, a substance (e.g., substance **94**) may be inserted into a cap

(e.g., cap **91**). Optionally, as indicated at block **220**, if the cap is not already attached to an in-vivo sensing device (e.g., device **40**), then the cap may be attached and/or bonded to the device. These operations may result in, for example, an in-vivo sensing device **40** which may include cap **91** which may contain substance **94**.

[**0049**] As indicated at block **230**, the in-vivo sensing device may be inserted into a body of a human being, e.g., into a patient's body. In one embodiment, for example, the device may be implemented using a swallowable capsule, and thus the device (e.g., device **40**) may be swallowed.

[**0050**] As indicated at block **240**, the substance may dissolve, or may change one or more of its properties. As indicated at block **250**, the device may collect measurements of the substance by using, for example a sensor. The collecting process may include for example sensing, imaging and/or monitoring one or more properties of the substance, for example as it dissolves or changes, and/or one or more properties of a body organ surrounding the device as the substance dissolves or changes.

[**0051**] As indicated at block **260**, the device may transmit captured data, for example, to receiver **12**. As indicated at block **270**, the data may be analyzed by a suitable processing unit, for example, by data processor **14**. Such analysis may, for example, produce one or more results or conclusions related to the dissolving or changing of the substance.

[**0052**] Some of the operations described above may be optional, and some embodiments may use another suitable order or sequence of operations. Furthermore, other suitable operations or sets of operations may be used in accordance with embodiments of the invention.

[**0053**] It is noted that a device, system and method in accordance with some embodiments of the invention may be used, for example, in conjunction with a substance (e.g., substance **94**) which may be inserted into a human body. However, the scope of the present invention is not limited in this regard. For example, some embodiments of the invention may be used in conjunction with a substance which may be inserted into a non-human body, e.g., a dog, a cat, a rat, a cow, or other animals, pets, laboratory animals, farm animals or pet animals. This may allow, for example, monitoring, sensing and/or imaging a substance as it dissolves inside a non-human body or an animal body.

[**0054**] While certain features of the invention have been illustrated and described herein, many modifications, substitutions, changes, and equivalents may occur to those of ordinary skill in the art. It is, therefore, to be understood that the appended claims are intended to cover all such modifications and changes as fall within the true spirit of the invention.

What is claimed is:

1. An in-vivo device comprising:

a compartment including a set of openings; and

an imager, the imager configured to image at least part of the compartment.

2. The device according to claim 1, wherein said in-vivo device is an autonomous capsule.

3. The device according to claim 1, comprising a sensor.

4. The device according to claim 3, wherein said sensor is selected from the group consisting of: a pH sensor, a temperature sensor, an electrical conductivity sensor, a pressure sensor.

5. The device according to claim 1, comprising an illumination source.

6. The device according to claim 1, comprising a transmitter.

7. The device according to claim 1, wherein the compartment is configured for containing a substance.

8. The device according to claim 1, wherein the compartment is configured to allow passage of fluids through the openings.

9. The device according to claim 1, wherein the compartment is at least partially transparent.

10. A device for in vivo sensing of a substance, said device comprising:

a holding unit, said holding unit configured for containing at least a substance; and

a transmitter.

11. The device according to claim 10, wherein said holding unit is disposed within said device.

12. The device according to claim 10, wherein said holding unit is detachable from said device.

13. The device according to claim 10, wherein said holding unit is external to said device.

14. The device according to claim 10, wherein said holding unit comprises a shell including at least one opening.

15. The device according to claim 10, wherein said holding unit is selected from the group consisting of: a basket, a cap, a pod, a bubble, or a case.

16. The device according to claim 10, comprising means to allow body liquids to pass in or out of said holding unit.

17. A system for in vivo sensing of a substance, the system comprising:

an autonomous in-vivo sensing device, said sensing device comprising a holding unit, said holding unit configured to contain the substance; and a transmitter; and

an external receiving unit.

18. The system according to claim 17, comprising a data processor.

19. The system according to claim 17, comprising a monitor.

20. A method for in vivo sensing of a substance the method comprising the steps of:

inserting said substance into an in vivo sensing device;

introducing said in vivo sensing device into a patient's body; and

sensing said substance.

21. The method according to claim 20, comprising inserting said substance into a holding unit.

22. The method according to claim 20, comprising imaging said substance.

23. The method according to claim 20, comprising transmitting sensed information to a receiving unit.

24. The method according to claim 20, comprising analyzing said sensed information.

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专利名称(译)	用于体内感测物质的装置，系统和方法		
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摘要(译)

一种体内装置和用于成像，监测和/或感测体腔中物质的方法。体内装置可包括保持单元，例如用于保持物质的帽，以及传感装置，例如传感器，成像器和照明源，用于捕获与物质中发生的变化有关的各种信息。