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(54) **Title:** PASSIVE TAG FOR MIMICKING A HUMAN BODY

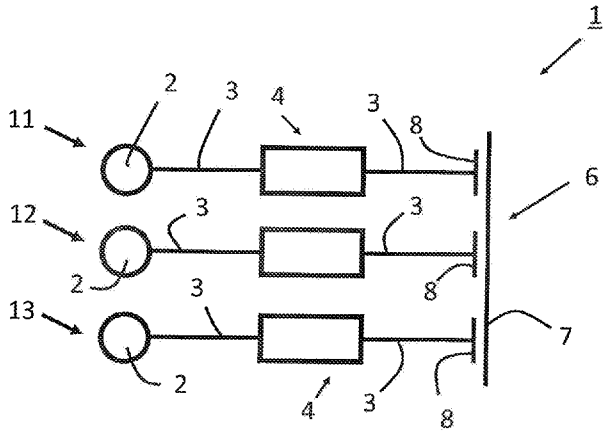

Fig. 1

(57) **Abstract:** Passive tag for mimicking a human body, comprising: -an electrically non-conductive substrate comprising a single or at least two electrically conductive contact pads, said single or at least two contact pads being arranged to interact with a touch screen of a detection device, such as a smartphone, when said passive tag is proximate to said touch screen; characterized in that said passive tag further comprises a human body mimicking circuit, said human body mimicking circuit comprising a conductive floating reference element and a single or at least two reference potential generation members, wherein each of said single or at least two reference potential generation members connects a respective contact pad of said single or at least two contact pads with said conductive floating reference element.

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Title: Passive tag for mimicking a human body

Description

The present invention relates to a passive tag for mimicking a human body, a stamp for forming a pattern on a touch screen, as well as a method for fabricating said passive tag.

A known tag comprises a non-conductive substrate having a multitude of pads at an outer surface of said substrate, an electrode at a further outer surface opposite to said outer surface, and a circuit connecting said pads to said electrode. Said pads are activated by touching said electrode with the skin of a person's hand, such that when said pads are adjacent to a touch screen, said touch screen is actuated via said pads.

A drawback of the known tag is that is inflexibly usable. In particular, because skin contact with said electrode is necessary to provide a connection to a human body to read out said pads with said detection device.

It is an object of the present invention to provide a tag that is more flexibly usable.

In a first aspect of the present invention, the object is achieved with a passive tag for mimicking a human body, comprising:

- an electrically non-conductive substrate comprising a single or at least two electrically conductive contact pads, said single or at least two contact pads being arranged to interact with a touch screen of a detection device, such as a smartphone, when said passive tag is proximate to said touch screen;

characterized in that said passive tag further comprises a human body mimicking circuit, said human body mimicking circuit comprising a conductive floating reference element and a single or at least two reference potential generation members, wherein each of said single or at least two reference potential generation members connects a respective contact pad of said single or at least two contact pads with said conductive floating reference element.

By providing said tag with a human body mimicking circuit, it is possible that said pads interact with a touch screen of a detection device, wherein said tag is free from an electrode at an outer surface of said substrate. This way, it is possible to use said tag wherein said tag is free from skin contact. Therefore said tag is more flexibly usable.

In other words, it is possible to use said tag to interact with a touch screen, without the need for skin contact, i.e. without the need to connect to a human body.

Within the context of the present invention, the terms non-conductive and conductive are used for indicating the relative conductive properties of a certain aspect / material. In this context, it is to be understood that a non-conductive material is significantly less conductive compared to a conductive material.

Within the context of this document, said conductive floating reference element is suitable for creating a virtual ground, i.e. a connection to a virtual ground not being a definite ground. In some embodiments, the conductive floating reference element is formed by a part of a capacitor. The stored electrical energy can be used for capacitive coupling with said detection device. Said conductive floating reference element forms a virtual ground in said circuit.

Within the context of this document, with the term proximate is meant near field communication, for example a range between 0 – 3 cm.

Said conductive floating reference element can comprise a capacitor, inductor, an electret, and/or a combination thereof.

Said virtual ground is defined as a node of said circuit that is maintained at a steady reference potential, wherein it is free from a direct connection to ground.

An electret is a dielectric material that has a quasi-permanent electric charge or dipole polarisation. When actuated, it generates an electric coupling with said pads to enable said pads to interact with said detection device.

Within the context of this document, said reference potential generation member is a member suitable for providing a current path to said pads, such that said pads can be detected by a detection device, such as a touch screen of a smartphone.

One of the advantages of the present disclosure is that no longer a human body is required to assure a detection of the tag by a touch screen, more specifically a smart phone or the like. The present disclosure enables the tag to be used without a human body, i.e. stand alone.

It was an insight of the inventor that by incorporating a human body mimicking circuit in the passive tag, it is no longer required to have a conductive

element at the circumference for connection to a human body. This improves the durability and life span of the passive tag.

In accordance with the present disclosure, a passive tag comprises a plurality of pads, wherein said tag is readable, or identifiable, by a detection device. Said detection device may uniquely identify said tag by identifying the positions of said pads with respect to each other. Said positions of said tag are, for example, determined by the distance between them and the orientation of said pads in a two dimensional plane. A passive tag can, for instance, be attached to clothing, or another object, by means of gluing, or stitching, wherein said tag carries information that can be read by said detection device.

Following the above, the inventors have found that, for accurate capacitive measurements, e.g. skin conductive measurements, or capacitive detection, e.g. detection of tags by the mobile phone capacitive display, a stable reference potential may be required. In general, this may be provided by the ground wire of a circuit or by a terminal which is connected via a distributed network of inductive, capacitive and/or resistive elements to ground, for example virtual ground. The human body can act e.g. as such a virtual ground.

For a number of applications such a connection to ground may not be available. Therefore, without a reference potential the capacitive measurement becomes at best highly inaccurate.

The current invention describes a solution to this problem in the form of an open circuit which provides an Alternating Current, AC, floating reference potential that can be used for e.g. capacitive measurements when a direct ground or indirect ground, i.e. virtual ground, is not available or possible. The open circuit can be implemented in different ways: for example using a capacitive element, an inductive element or an electrostatic element, or anything alike. This will be explained in more detail here below.

Examples of the present invention are described below.

In an example said passive tag is free from a power source, such as a battery. This way, said passive tag is more durable.

In this particular example the floating reference element may be electrically induced using the environment, or using the touch screen of the smart phone itself.

In an example said tag is free from a conductive or electromagnetic ground.

In an example each of said at least two reference potential generation members comprises a respective resistor. An advantage of this example is that each reference potential generation member can generate, in combination with said floating reference element, a similar coupling between said respective pad and said floating reference element.

More specifically, the above described resistors may have the same resistance value such that the coupling between the respective pad and the floating reference element is substantially the same.

In an example each of said at least two reference potential generation members comprises a respective first capacitor part, wherein said conductive floating reference element forms a common capacitor part cooperating with each first capacitor part. An advantage of this example is that a relatively compact passive tag can be provided.

It was the insight of the inventors that a common capacitor part may be introduced for forming the floating reference element. The advantage hereof is that a compact design is obtained for storing electrical energy while improving the human body mimicking properties of the tag. Yet another advantage relates to the manufacturing of the passive tag. A common capacitor part may be obtained by introducing a plate shaped conductive element.

In an example said common capacitor part and/or each of said respective first capacitor parts is plate shaped. This way, said passive tag can be relatively efficient and compact.

In an example an insulation layer is arranged between each of said first capacitor parts and said common capacitor part. Said insulation layer can be, for instance, a space containing air, or a dielectric material.

In an example said floating reference element comprises an inductor. The inductor may be used to induce electrical coupling between said pad and said floating reference element.

In an example said inductor is circle shaped. Preferably said circle is formed by a line of conductive material, wherein said line spirals around from an outer starting point, around a central axis, towards an end point near said axis.

In an example said conductive floating reference element comprises an electrostatic element. Said electrostatic element is, for instance, an electret. An advantage of this example is that a charge can be provided at said floating reference element by polarising said electret.

In an example each reference potential generation member is identical. An advantage of this example is that, in use, each reference potential generation member provides a similar current. This way a more stable current is provided.

In an example said human body mimicking circuit comprises said conductive floating reference element and each of said reference potential generation members comprises any of a capacitor, inductor, and a resistor, wherein any of said conductive floating reference element, capacitor, inductor and resistor is any of:

- printed on said substrate;
- one or more analogue components.

With analogue components is meant that external hardware components comprising of material that is different from said substrate and/or said conductive material. An analogue component is for instance a readymade assembled component, such as a conductor, or a resistor, etc., that can be attached to said substrate by, for instance, soldering.

With 3D printing is meant a manufacturing process that forms layers of material to create a three-dimensional object. Often said object is formed by forming multiple layers on top of each other. Said forming is, for instance, achieved by positioning layers of (partially) liquid (non-) conductive material, or hardening layers of photosensitive material by exposing said photosensitive material to light. In practice said object is based on a digital blueprint of, for instance, a physical model, or a CAD-drawing.

An advantage of printing said components onto said substrate is that a compact and durable connection between said human body mimicking circuit and said substrate can be provided.

An advantage of connecting analogue components is, that components can be connected to said substrate directly.

In an example said resistor has an electrical resistance of 0,5 to 1,5 kOhm, more specifically approximately 1kOhm, said capacitor has a capacitance of 1 to 100 pFarad, more specifically approximately 50 pFarad,

In an example said inductor has a inductance of 1 to 1000 nanoHenry, more specifically approximately 500 nanoHenry.

In an example an insulation layer is provided between said reference potential generation members. This reduces the risk of disturbances among reference potential generation members.

Advantages of the second and third aspect below correspond with those of the first aspect.

In a second aspect the invention provides a stamp for forming a pattern on a touch screen of a detection device, comprising a passive tag according the first aspect. Preferably said stamp comprises a plurality of pads, each connected to a respective reference potential generation member, wherein each respective reference potential generation member is in turn connected to said floating reference element particular. It is however possible that a series of pads is connected to a respective reference potential generation member. With a plurality of pads or a series of pads, it is possible to form a pattern forming a plurality of readable positions to be detected by a detection device.

In a third aspect, the present disclosure provides for a method for fabricating a passive tag for mimicking a human body, said human body comprising:

- an electrically non-conductive substrate comprising a single or at least two electrically conductive contact pads, said single or at least two contact pads being arranged to interact with a touch screen of a detection device, such as a smartphone, when said passive tag is proximate to said touch screen;

wherein said passive tag further comprises a human body mimicking circuit, said human body mimicking circuit comprising a conductive floating reference element and a single or at least two reference potential generation members, wherein each of said single or at least two reference potential generation members connects a respective contact pad of said single or at least two contact pads with said conductive floating reference element,

said method comprising the steps of:

1) providing an insulation layer on top of said substrate;

2) folding said substrate such that a first part of said substrate is on top of a second part of said substrate, or stacking said first part of said substrate on top of said second part of said substrate, wherein said first part comprises said common capacitor part of said conductive floating reference element and wherein said

second part comprises said plurality of first parts of said capacitor such that a plurality of capacitors are formed between said common capacitor part and each of said plurality of first parts of said capacitor.

In accordance with the present disclosure, the substrate may be folded such that the first part of the substrate is on top of the second part of the substrate.

The passive tag is, typically, used in applications that have an inherent lack of space. Space is saved, reduced, by folding the first part of the substrate on top of the second part of the substrate.

In accordance with the present disclosure, the first part of the substrate may also be stacked on top of the second part of the substrate. Again, this improves the amount of space that is taken by the passive tag.

The passive tag that is construed, comprises contact pads in a certain layout; an insulation layer is provided on top of the contact pads and a virtual ground, i.e. a human body mimicking circuit, is situated on top of the insulation layer. The insulation layer, or layers, has an effective dielectric constant ε and thickness D. The electrical distance d_e of the human body mimicking circuit to the touch screen of a detection device is to be sufficiently large to prevent capacitive coupling with the touch screen such that the human body mimicking circuit can not be recognized.

From an electrical perspective, it may be assumed that the human body mimicking circuit is not being recognized when the capacity between the human body mimicking circuit and the touch screen smaller is than approximately 5 pF. It may further be assumed that the contact pads may nog be recognized when the surface area is larger than about $1cm^2$. Larger surface areas could be filtered from the screen by the software running on the detection device as being a background parasitic capacitor.

The capacity from the human body mimicking circuit to the touch screen may be expressed as $C = \varepsilon_0 A/d_e$. This means that the minimum needed electrical thickness for not recognizing the human body mimicking circuit is roughly 175 micrometre. Most electrical insulators have an ε_r between 1.5 and 5. This means that the effective thickness of the insulation layer may, in practice, need to be minimum 250 micronmetre till 875 micronmetre thick.

As a safe lower limit for the thickness of the insulation layer a thickness of about 100 micrometre may be used. Preferably, a thickness of about 100-

500 micrometre may be used in combination with an ε_r of 2.5, which is then possible in PCB technology. This may enable stacking of laminating the layers.

In an example, said step 1) comprises:

- providing an insulation layer on top of said substrate, wherein said insulation layer has a thickness of at least 100 micrometre.

In a further example, step 2) comprises:

- stacking said first part of said substrate on top of said second part of said substrate, wherein said first part of said substrate comprises at least one via such that each of said single or at least two reference potential generation members connects said respective contact pad of said single or at least two contact pads via said at least one via.

In case of stacking, the connections may be made using a via, or may be made using a capacitive coupling.

In a further example, the step of printing said passive tag uses a 3D printer.

In another example, the step of printing said passive tag comprises printing said human body mimicking circuit using an electronics printer material.

Here, the step of printing the passive tag may comprise printing the substrate.

Each of said at least two reference potential generation members may comprise a respective resistor.

In an example, each of said at least two reference potential generation members may comprise a respective first capacitor part and said conductive floating reference element forms a common capacitor part cooperating with each first capacitor part.

In a further example, the common capacitor part and/or each of said respective first capacitor parts is plate shaped.

In an example, the floating reference element comprises an inductor which may be circular shaped.

The conductive floating reference element may comprise an electrostatic element.

In a further example, the human body mimicking circuit comprises said conductive floating reference element and each of said reference potential generation members comprises any of a capacitor, inductor, and a resistor, wherein

any of said conductive floating reference element, capacitor, inductor and resistor is any of:

- printed on said substrate;
- one or more analogue components.

In an example, at least one of:

- said resistor has an electrical resistance of 0 to 1 MOhm, more specifically approximately 1kOhm, said capacitor has a capacitance of 1 pF to 300 nF, more specifically approximately 30 nF;
- said inductor has an inductance of 1 nH to 100 µH, more specifically approximately 500 nH.

It is noted that it may be beneficial to add an additional, for example coloured, layer to the stack . A coloured layer may hide the contact pads thereby improving the safety aspects of the passive tag.

In the situation in which the metal of the contact pads may come in direct contact with the touch screen, the extra layer may be placed in between the layer having the contact pads and the touch screen. In this particular situation, the additional layer adds to the resistance of the active circuit. This improves the recognition process of the contact pads because the human body mimicking circuit resembles the human body even more.

In the situation in which the substrate may be in contact with the touch screen, the additional layer may be placed in between the substrate and the contact pads. This may improve the capacitive behaviour.

Following the above, in an example, said method comprises the step of:

- providing a non-transparent layer on said substrate such that said single or at least two contact pads are covered.

More specifically, the step of providing may comprise any of:

- providing said non-transparent layer as an outer layer thereby covering said single or at least two contact pads;
- providing said non-transparent layer in between a foil, comprised by said substrate, and said single or at least two contact pads.

In a third aspect the invention provides a method for fabricating a passive tag according to the first aspect, comprising the step of printing said passive

tag using a 3D printer. With a 3D printer it is possible to print a large variety of different circuits.

In an example of the third aspect the step of printing said human body mimicking circuit comprises using an electronics printer material, such as a conductive ink, or dielectric ink. Said conductive ink can comprise, for instance, silver, gold, carbon black.

In an example of the third aspect said step of printing said reference potential generation members comprises printing a plurality of first capacitor parts of each of said plurality of reference potential generation members respectively, and a common capacitor part of said conductive floating reference element, each first capacitor part and said common capacitor part together forming a capacitor. An advantage of this example is that a relatively compact human body mimicking cicruit can be provided. Moreover, because said parts are printed, they can be easily arranged on (or in) said substrate.

In an example of the third aspect said step of printing said reference potential generation members comprises printing a plurality of first capacitor parts of each of said plurality of reference potential generation members, and wherein said method further comprises the steps of:

- providing an insulation layer on top of said substrate;
- providing a conductive layer on top of said insulation layer, wherein said conductive layer forms a common capacitor part of said conductive floating reference element for each said first capacitor parts.

This way a relatively compact passive tag is achieved.

In an example of the third aspect said step of printing said passive tag comprises printing said substrate. An advantage of this example is that said substrate can be printed such that said substrate surrounds said circuit, thereby providing a stable connection between said substrate and said circuit. Moreover, it is possible to completely surround said floating reference element with said substrate, thereby reducing the risk that said floating reference element is directly contacted by, for instance, a conductive object other than a part being part of said circuit.

In an example of the third aspect said method further comprises the steps of:

- providing an insulation layer on top of said substrate;

- folding said substrate such that a first part of said substrate is on top of a second part of said substrate, wherein said first part comprises said common capacitor part of said conductive floating reference element and wherein said second part comprises said plurality of first parts of said capacitor such that a plurality of capacitors are formed between said common capacitor part and each of said plurality of first parts of said capacitor. In this case it is possible that said first capacitor parts are arranged on a first section of said substrate, and said common capacitor part is arranged on a second section of said substrate, wherein said second section is foldable towards said first section such that said common capacitor part is overlapping said first capacitor parts. In particular, said first capacitor parts are, prior to said folding, arranged in substantially the same plane as said common capacitor part.

An advantage of this example is that a compact passive tag can be achieved relatively quickly.

The above-mentioned and other features and advantages of the invention will be best understood from the following description referring to the attached drawings. In the drawings, like reference numerals denote identical parts or parts performing an identical or comparable function or operation.

The invention is not limited to the particular examples disclosed below in connection with a particular type of passive tag.

Figure 1 presents a schematic view of a possible embodiment of a human body mimicking circuit of a passive tag according to the invention.

Figure 2 presents a schematic cross sectional view of said passive tag of Figure 1.

Figure 3 presents a possible embodiment of a human body mimicking circuit according to the invention.

Figure 4 presents a schematic view of an inductor for use in a circuit of an embodiment of the present invention.

Figure 5 presents a perspective view of a possible embodiment of a passive tag according to the present invention.

Figure 1 presents a schematic view of a human body mimicking circuit 1 for use in a passive tag 10. Said circuit 1 comprises three identical circuit parts 11, 12, 13. Each circuit part 11, 12, 13 comprises an electrically conductive contact pad

2, and a respective reference potential generation member 4 with a capacitor part 8. Electrically conductive lines 3 connect each of said pads 2 to each respective reference potential generation member 4 and each capacitor part 8. Each capacitor part 8 forms a capacitor 6 with a common capacitor part 7. Said capacitor parts 7, 8 together form a capacitive conductive floating reference element 6.

Each of said capacitor parts 8 and said common capacitor part 7 are substantially flat. Said parts 7, 8 can be, for instance, plate shaped or formed by a curved or bevelled, for instance, spiral line of conductive material.

Said reference potential generation member 4 comprises a resistor (not shown in Figure 1 and 2) and a capacitor part 8. It is however also possible that each reference potential generation member 4 comprises a resistor, an inductor and/or a capacitor.

In Figure 1 and 2 said floating reference element 6 is formed by a capacitor. However, said floating reference element can also be formed by connecting inductors 9 of said reference potential generation member 4 as can be seen in Figure 3.

For making a tag visible to a touchscreen of a smartphone a potential difference/stabilization between the stamp and the touchscreen may be needed. Otherwise no disturbances may be noticed in the capacitive field of measured by the touchscreen controller. None of the existing solutions are flexible and can be additive integrated into existing systems.

The same problem holds for wireless sensors in which charge and discharge potential stabilization is needed to filter out noise over wires.

All current tag and/or capacitive touch pens that interact with the capacitive sensors of the touchscreen of a smartphone are based on a virtual ground circuit where a real person provides the virtual ground. When the tag is disconnected from ground or from a person, the tag is not recognized anymore by the mobile phone.

For accurate measurements of e.g. muscle voltage of a person a balanced capacitive measurement may be needed to filter out the common mode noise. For this type of circuit, a reference electrode far away of the two signal electrodes is needed to provide a virtual ground reference, for example via the body RLC network.

Figure 2 presents a cross sectional side view of a passive tag 10 comprising an electrically non-conductive substrate 14 having a circuit like that of

Figure 1 printed connected to said substrate 14. Said pad 2 is arranged at an outer surface 15 of said substrate 14 such that it can communicate with a detection device (not shown), for instance, by means of near field communication (NFC), such as, for instance, radiofrequency identification (RFID), or electromagnetic coupling. Said pad 2 is connected via a conductive line 3 with said reference potential generation member 4, which in turn is connected, via a further line 3, to a first generation member side part 8 of said reference potential generation member 4. Adjacent to said first capacitor part 8 said common capacitor part 7 is arranged, wherein said common capacitor part 7 is free from contact with any conductive object. Also a space is provided between said first capacitor parts 7 and said common capacitor part 7. Said floating reference element 6 is arranged to couple electrically with said pads.

Figure 3 presents a possible embodiment of a human body mimicking circuit 1 of the present invention. Said circuit 1 comprises two pads 2 for interacting with a detection device, wherein each of said two pads 2 is connected, via respective lines 3, to a respective reference potential generation member 4 having a respective further line 3 and a respective inductor 9. Said inductor 9 is connected to a common floating reference element 6, indicated by a dashed line 6, forming a virtual ground of said circuit 1. Said pads 2 are thus indirectly, via said circuit 1, connected to each other. In Figure 3 said common floating reference element 6 is connected to each inductor 9. It is however also possible that each inductor 9 is connected to a respective floating reference element 6 wherein said respective floating reference elements are free from a connection to each other, i.e. wherein said floating reference elements are not connected to each other.

In the embodiments of the present invention, said conductive material is, for instance, copper or silver.

Figure 4 shows four inductor arrangements A, B, C, D for use in said reference potential generation members 4 and/or said floating reference element. Each of said inductors A, B, C, D are substantially flat and formed by a line 24 of conductive material. Said line 24 has rounded or bevelled corners, wherein said line 24 spirals around a central axis 23 from a starting point 21 towards an end point 22.

Figure 5 presents a perspective view of an embodiment of a passive tag 10 according to the present invention. Said passive tag 10 comprises a substrate 14 and a human body mimicking circuit 1 having two circuit parts 11, 12 attached to said substrate 14, a dielectric layer 33, and a common capacitor part 7.

Said substrate 14 comprises edges 35, 36, 37, 38 that define a substrate plane for providing a basis for said human body mimicking circuit 1. Said substrate 14 comprises a first 39 and a second section 40 which are divided by a folding line 31. Said folding line extends perpendicular to said edges 35, 36 from edge 35 to edge 36 in said plane defined by said edges 35, 36, 37, 38. Near said folding line 31 said edges 35, 36 are provided with a recess 34. Also, said edges 35, 36 are each provided with further recesses near said edge 38 and edge 39.

Said human body mimicking circuit 1 comprises two circuit parts 11, 12. Each circuit part 11, 12 comprises a conductive pad 2, a conductive line 3 and a conductive reference potential generation member 4 arranged on said substrate 14.

Said pads 2 are arranged adjacent to said edge 38, whereas said first capacitor parts 8 and said common capacitor 7 are arranged near said edge 37, which edge 37 is opposite to said edge 38.

Said reference potential generation member 4 comprises a resistor 32 and a first capacitor part 8. Said first capacitor part 8 is plate shaped, wherein said plate shape extends substantially in said plane of said substrate 14. As can be seen in Figure 5, said first capacitor parts 8 extend solely in said second section 40. Said resistor 32 is closer to said pad 2 than said first capacitor part 8.

Said dielectric layer 33 is positioned above said substrate 14, said pads 2, said lines 3, and said reference potential generation members 4. Said dielectric layer 33 provides a non-conductive layer between said first capacitor parts 8 of said reference potential generation member 4 and said common capacitor part 7. Said dielectric layer 33 extends between said edges 35, 36, 37, 38, wherein said layer 33 overlaps said second section 40 completely and said first section 39 partially.

Said common capacitor part 7 is arranged above said dielectric layer 33, wherein said common capacitor part 7 is further away from said substrate 14 than said dielectric layer 33. Said common capacitor part 7 extends between said edges 35, 36, 37 and said folding line 31, such that said common capacitor part 7 overlaps each of said first capacitor parts 8.

A connection between said substrate 14, said circuit 1, said dielectric layer 33 and said common capacitor part 7 can, for instance, be achieved by means of gluing, or material binding of 3D printed material.

When said substrate 14, said circuit 1, and dielectric layer 33, and said common capacitor part 7 are connected to each other said first section 39

comprises said pads 2, a piece of said lines 3, and a piece of said dielectric layer 33. In this case said second section 40 comprises another piece of said lines 3, said reference potential generation members 4 with said resistors 32 and said first capacitor parts 8, another piece of said dielectric layer 33, and said common capacitor part 7.

Said folding line 31 forms a line over which said second section 40 can be folded towards said first section 39. In this case, said dielectric layer 33 comprises a similar folding line (not shown).

When said second section 40 is folded onto said first section 39 a passive tag 10 is formed that comprises, from top to bottom, the following layers:

- a substrate layer comprising pads 2;
- a dielectric layer;
- a common capacitor layer comprising said common capacitor 7;
- another dielectric layer; and
- a substrate layer comprising said reference potential generation members 4.

In Figure 1, 2, 3 and 5 each show that pad 2 is connected to a reference potential generation member 4. It is, however, also possible that a number of pads 2 are connected consecutively, in series, to said floating reference element 6 via a single reference potential generation member 4. In this case the pads 2 are connected to each other via conductive lines.

Said passive tag may have a plurality of voltage generating elements and a plurality of conductive elements to form a distributed network.

It should be clear that the description above is intended to illustrate the operation of preferred examples of the present invention, and not to reduce the scope of protection of the invention. Starting from the above description, many embodiments will be conceivable to the skilled person within the inventive concept and scope of protection of the present invention. The scope of protection is defined by the claims below.

CLAIMS

1. A method for fabricating a passive tag for mimicking a human body, said human body comprising:

- an electrically non-conductive substrate comprising a single or at least two electrically conductive contact pads, said single or at least two contact pads being arranged to interact with a touch screen of a detection device, such as a smartphone, when said passive tag is proximate to said touch screen;

wherein said passive tag further comprises a human body mimicking circuit, said human body mimicking circuit comprising a conductive floating reference element and a single or at least two reference potential generation members, wherein each of said single or at least two reference potential generation members connects a respective contact pad of said single or at least two contact pads with said conductive floating reference element,

said method comprising the steps of:

1) providing an insulation layer on top of said substrate;

2) folding said substrate such that a first part of said substrate is on top of a second part of said substrate, or stacking said first part of said substrate on top of said second part of said substrate, wherein said first part comprises said common capacitor part of said conductive floating reference element and wherein said second part comprises said plurality of first parts of said capacitor such that a plurality of capacitors are formed between said common capacitor part and each of said plurality of first parts of said capacitor.

2. A method in accordance with claim 1, wherein said step 1) comprises:

- providing an insulation layer on top of said substrate, wherein said insulation layer has a thickness of at least 100 micrometre.

3. A method in accordance with any of the previous claims, wherein said step 2) comprises:

- stacking said first part of said substrate on top of said second part of said substrate, wherein said first part of said substrate comprises at least one via such that each of said single or at least two reference potential generation members connects said respective contact pad of said single or at least two contact pads via said at least one via.

4. A method in accordance with any of the previous claims, comprising the step of printing said passive tag using a 3D printer.

5. A method in accordance with claim 4, wherein said step of printing said passive tag comprises printing said human body mimicking circuit using an electronics printer material.

6. A method in accordance with claim 4, wherein said step of printing said passive tag comprises printing said substrate.

7. A method in accordance with any of the previous claims, wherein each of said at least two reference potential generation members comprises a respective resistor.

8. A method in accordance with any of the previous claims, wherein each of said at least two reference potential generation members comprises a respective first capacitor part and said conductive floating reference element forms a common capacitor part cooperating with each first capacitor part.

9. A method in accordance with any of the previous claims, wherein said common capacitor part and/or each of said respective first capacitor parts is plate shaped.

10. A method in accordance with any of the previous claims, wherein said floating reference element comprises an inductor.

11. A method in accordance with any of the previous claims, wherein said inductor is circle shaped.

12. A method in accordance with any of the previous claims, wherein said conductive floating reference element comprises an electrostatic element.

13. A method in accordance with any of the previous claims, wherein each reference potential generation member is identical.

14. A method in accordance with any of the previous claims, wherein said human body mimicking circuit comprises said conductive floating reference element and each of said reference potential generation members comprises any of a capacitor, inductor, and a resistor, wherein any of said conductive floating reference element, capacitor, inductor and resistor is any of:

- printed on said substrate;
- one or more analogue components.

15. A method in accordance with any of the previous claims, wherein at least one of:

- said resistor has an electrical resistance of 0 to 1 MOhm, more specifically approximately 1kOhm, said capacitor has a capacitance of 1 pF to 300 nF, more specifically approximately 30 nF;
- said inductor has an inductance of 1 nH to 100 µH, more specifically approximately 500 nH.

16. A method in accordance with any of the previous claims, wherein said method comprises the step of:

- providing a non-transparent layer on said substrate such that said single or at least two contact pads are covered.

17. A method in accordance with claim 16, wherein said step of providing comprises any of:

- providing said non-transparent layer as an outer layer thereby covering said single or at least two contact pads;
- providing said non-transparent layer in between a foil, comprised by said substrate, and said single or at least two contact pads.

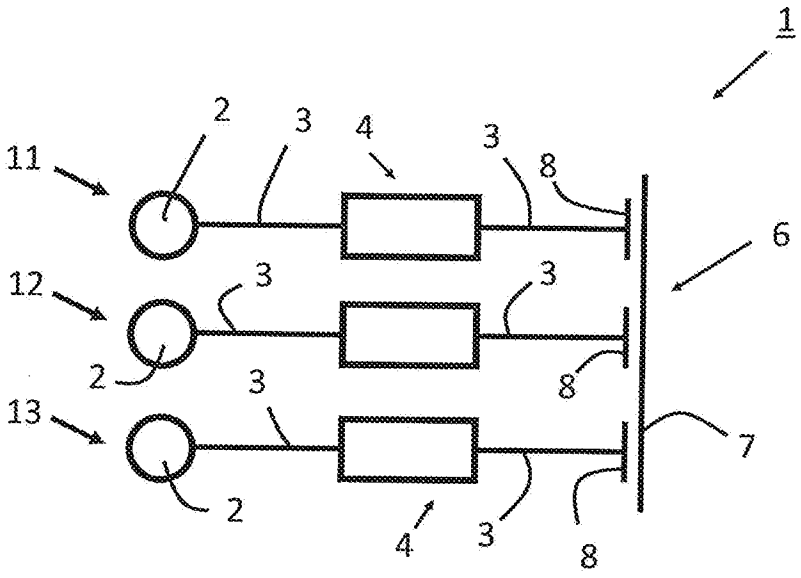

Fig. 1

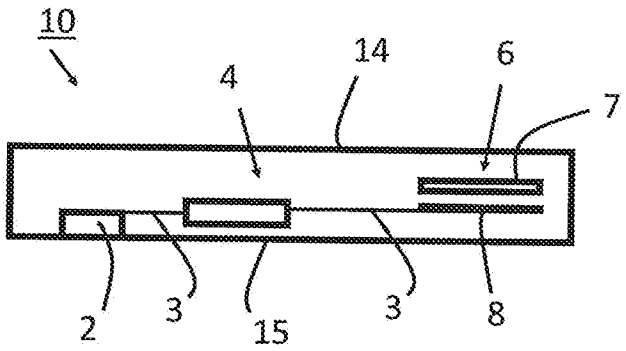

Fig. 2

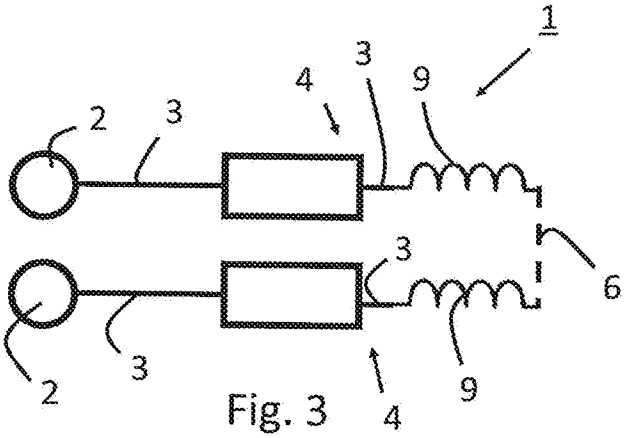

Fig. 3

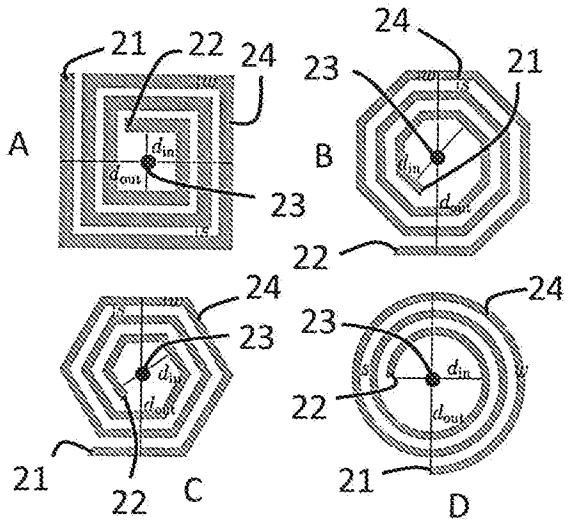

Fig. 4

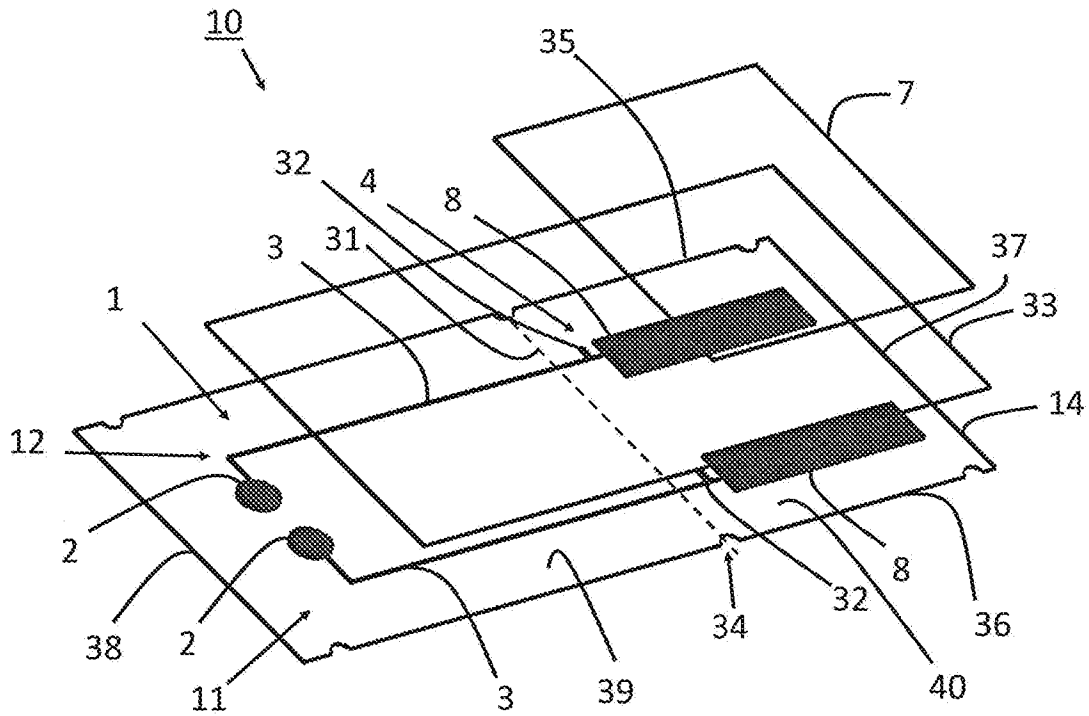

Fig. 5

INTERNATIONAL SEARCH REPORT

International application No
PCT/NL2019/050685

A. CLASSIFICATION OF SUBJECT MATTER
INV. G06F3/039 G06F3/0354
ADD.

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

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)
EPO-Internal, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	US 2011/157056 A1 (KARPFINGER COLIN [US]) 30 June 2011 (2011-06-30) paragraph [0069] - paragraph [0070]; figures 11-13	1-17
Y	US 4 369 557 A (VANDEBULT JAN [US]) 25 January 1983 (1983-01-25) column 9, line 17 - line 63; figures 1-7	1-17
A	CA 2 899 351 A1 (MATULIS HENRIQUE [CA]) 5 February 2017 (2017-02-05) claim 1; figure 9	1-17
A	US 6 407 669 B1 (BROWN KATHERINE A [US] ET AL) 18 June 2002 (2002-06-18) page 9, line 28 - page 10, line 22; figures 1-3	1-17

☐ Further documents are listed in the continuation of Box C.

☒ See patent family annex.

* Special categories of cited documents :

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"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
25 March 2020	02/04/2020

Name and mailing address of the ISA/	Authorized officer
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INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No
PCT/NL2019/050685

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 2011157056 A1	30-06-2011	NONE	
US 4369557 A	25-01-1983	EP 0059723 A1	15-09-1982
		US 4369557 A	25-01-1983
		WO 8200541 A1	18-02-1982
CA 2899351 A1	05-02-2017	NONE	
US 6407669 B1	18-06-2002	AU 2002230723 A1	19-08-2002
		CN 1488122 A	07-04-2004
		EP 1356428 A2	29-10-2003
		JP 2004519042 A	24-06-2004
		US 6407669 B1	18-06-2002
		WO 02063551 A2	15-08-2002