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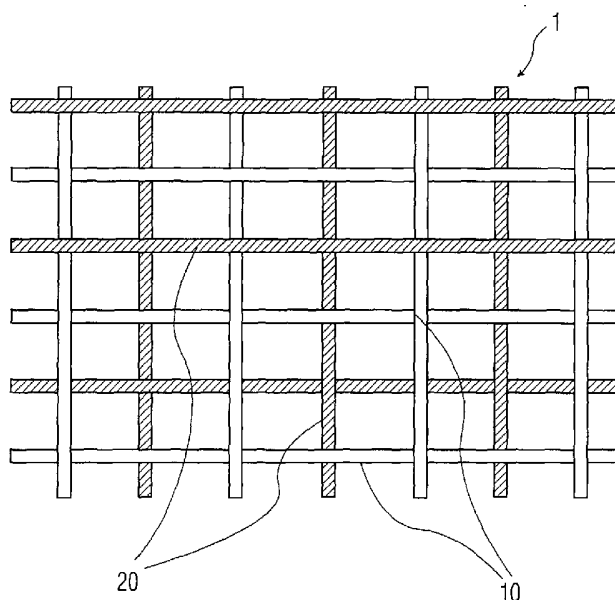
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(54) Title: A FABRIC INTERFACE



(57) Abstract: There is provided a flexible, lightweight high-performance electronic fabric interface (30) that can be integral with a wearable garment (60) and can cooperate with any of a variety of different wearable electronics (65) and the like without compromising the comfort and/or durability of the garment (60). The fabric interface is formed from a flexible fiber construction of one or more conductive fibers (10) and one or more non-conductive fibers (20), the non-conductive fibers including one or more fibers having elastomeric properties.



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A FABRIC INTERFACE

The present invention relates to wearable electronics. More particularly, the present invention relates to a flexible fabric interface suitable for a variety of wearable electronic applications and/or operations.

5 The use of wearable electronics in various sewn or woven materials is well known, see for example, U.S. patent No. 6,210,771 B1 and PCT International Patent Publication No. WO 02/32665 A1. Devices such as conductive traces, bio-sensors, electrodes, computers, electronic circuits and the like have all been incorporated into fabric. As the benefits associated with the various types and/or
10 configurations of wearable electronics and the corresponding fabric or material become more apparent, the desirability and need for simple, effective and efficient, as well as intuitive user interface solutions becomes more apparent. Hence, there is a need for an interface that is complementary to the various electronic functions provided by the different wearable electronic devices and/or the materials
15 accommodating such devices.

It is an object of the present invention to provide an interface suitable to address the above-identified need for simple, effective and efficient, as well as intuitive user interface solutions.

It is another object of the present invention to provide such an interface that
20 has a flexible fiber construction.

It is another object of the present invention to provide such an interface that can be selectively revealed and/or accessed.

It is another object of the present invention to provide such an interface that combines conductive material with non-conductive flexible material.

It is another object of the present invention to provide such an interface that is suitable for facilitating intuitive user interface solutions for wearable electronics.

5 It is still another object of the present invention to provide such an interface suitable for accomplishing a variety of different operations.

It is further another object of the present invention to provide such an interface capable of cooperating with a variety of different electronic devices and/or equipment.

10 These and other objects and advantages of the present invention are achieved by an interface fashioned from an appropriate blend of conductive material and flexible non-conductive material. The interface can take the form of any number of electronic switches and/or controls suitable for providing user interface solutions for wearable electronics. The interface can be selectively revealed and/or
15 accessed coincident with the interface being stretched or extended.

Fig. 1 is a plan view of a fiber mesh or construction in accordance with an illustrative embodiment of the present invention;

Fig. 2 is a plan view of an interface in accordance with an illustrative embodiment of the present invention with the interface being in a relaxed or
20 inaccessible state;

Fig. 3 is a plan view of the interface of Fig. 2 with the interface being in a stretched, extended or accessible state; and

Fig. 4 is a front view of a garment incorporating the interface of Figs. 2 and 3 in accordance with an illustrative embodiment of the present invention.

5 Referring to the drawings and, in particular, Fig. 1, a fiber mesh or construction in accordance with an illustrative embodiment of the present invention is shown and generally represented by reference numeral 1. Preferably, fiber construction 1 has a combination of one or more conductive fibers 10 and one or more non-conductive fibers 20. The non-conductive fibers 20 including one or more elastic fibers 20 for
10 cooperating with the one or more conductive fibers 10 to fashion a flexible electronic fabric interface 30.

Preferably, the fabric interface 30 can be formed into a multitude of different patterns facilitating different applications in use. The fabric interface 30 preferably can cooperate with a variety of different electronic devices, such as for example,
15 various wearable electronics, biosensors, medical instruments, or health therapy equipment. The fabric interface 30 may also operate independently to accomplish a variety of different electronic operations. The fabric interface 30, in addition to being formed from a combination of individually woven fibers, as noted above, can also be formed from an appropriate combination of material layers having
20 conductive properties and being suitable to form the one or more electrical switches and/or controls. The fabric interface 30 can be any desired shape, size or configuration necessary to accomplish a desired operation.

Preferably, the one or more conductive fibers 10 can be intertwined with the one or more non-conductive fibers 20 using any known conventional method for weaving, sewing or knitting. Preferably each conductive fiber 10 can have any of a variety of forms. For example, conductive fibers 10 can have a conductive

5 threadlike core enclosed by a conductive semi-fluid sleeve. The core and sleeve preferably being bonded together via sonic welding. It is noted that other connecting methods may also be used. Conductive fibers 10 can be formed from any of a variety of materials and/or combination of materials. For example, conductive fibers 10 can be fashioned from metalized foils, conductive polymers,

10 graphitized/metalized fibers, or conductive gels (e.g., conductive silicon), or any combination of the same.

Preferably, each conductive fiber 10 has properties suitable to provide sufficient flexibility and durability to withstand the stresses associated with the manufacture and wear of a variety of different types of garments. Each conductive

15 fiber 10 preferably also facilitates electrical communication between an electrical power source (not shown) and the fabric interface 30 via the fiber construction 1. Preferably, the fabric interface 30 can, in turn, facilitate power being provided to any of a variety of wearable electronics. A connector (not shown) preferably can provide a medium for the electrical communication between the electrical power

20 source and fiber construction 1. The connector can have any configuration suitable to provide the means or way for this electrical communication. Conductive fibers 10 can preferably also have different shapes, sizes or configurations such that fiber construction 1 can have different adaptations to accommodate different uses.

Preferably each non-conductive fiber 20 can have, in addition to an appropriate amount of elasticity and/or extensibility, properties that facilitate comfortable interaction with the skin, such as for example, lycra, spandex, neoprene, polyester, and/or a rubber extruded fibers. Non-conductive fibers 20 can also preferably have different shapes, sizes or configurations such that fiber construction 1 can have different adaptations to accommodate different uses. It is noted that not all of the non-conductive fibers need have elastomeric properties and that a composite of elastomeric fibers and non-elastomeric materials may also be used to accomplish the intended purposes of the present invention.

10 Thus, the fiber construction 1 preferably forms a highly flexible, lightweight high-performance electronic interface that is capable of being integral with a wearable garment and of cooperating with any of a variety of different wearable electronics and the like without compromising the comfort and/or durability of the garment.

15 Having described some of the preferred characteristics of an illustrative embodiment, the process or method for forming a flexible fabric interface 30, preferably includes at least the following steps. First, referring to Figs. 1 and 2, fashioning one or more conductive fibers 10 and one or more non-conductive fibers 20 into a flexible fiber construction 1, then, referring to Fig. 3, stretching the fiber construction 1 to an extended state, and then, referring to Figs. 2 and 3, patterning interface graphics 40 on the stretched fiber construction. Preferably, the interface graphics 40 can be suitable for cooperating with various types of wearable

electronics and like devices. The interface graphics 40 may also preferably be suitable for user interaction. In addition, the interface graphics 40 can be either part of, or integral with, an abstract or decorative pattern associated with a garment. It is noted that when the fiber construction 1 is in a stretched or extended state the fabric interface 30 is revealed and/or accessible, and that when the fiber construction 1 is in a non-stretched or non-extended state the fabric interface 30 is hidden, unnoticeable or substantially hidden. It is further noted that the fiber construction 1 can have a securing system 50, such as for example, a Velcro arrangement as shown in Fig. 4, or a popper arrangement, or any other similar type of securing arrangement sufficient to selectively hold the fiber construction 1 in the stretched or extended state.

The present invention having been thus described with particular reference to the preferred forms thereof, it will be obvious that various changes and modifications may be made therein without departing from the spirit of the present invention as defined herein.

WHAT IS CLAIMED IS:

1. A fiber construction (1) comprising:
one or more conductive fibers (10); and
one or more non-conductive fibers (20) cooperating with said one or more
5 conductive fibers (10) to fashion at least one fabric interface (30), wherein said non-
conductive fibers (20) provide elasticity to the fiber construction (1) such that said
at least one fabric interface (30) is selectively revealed and/or can be accessed
coincident with an extension of the fiber construction.
2. The fiber construction (1) of claim 1, wherein said one or more
10 conductive fibers 10 are made from a one or more conductive materials.
3. The fiber construction (1) of claim 2, wherein said one or more
conductive materials can be selected from one or more of the following: conductive
polymers, conductive metalized fibers, conductive graphitized fibers, conductive
metalized foils, or conductive gels, or any combination of the same.
- 15 4. The fiber construction (1) of claim 1, wherein said one or more
conductive fibers (10) are made from a composite of conductive materials.
5. The fiber construction (1) of claim 1, wherein said one or more non-
conductive fibers (20) are made from one or more elastomeric materials.

6. The fiber construction (1) of claim 5, wherein said one or more elastomeric materials can be selected from one or more of the following: lycra, spandex, neoprene, polyester, and/or any rubber extruded material, or any combination of the same.

5 7. The fiber construction (1) of claim 1, wherein said one or more non-conductive fibers (20) are made from a composite of elastomeric materials.

8. The fiber construction (1) of claim 1, wherein said at least one fabric interface has interface graphics (40) for user interaction.

9. The fiber construction (1) of claim 1, wherein said fiber construction
10 (1) can have a securing system (50) for selectively holding said fiber construction (1) in a stretched or extended state.

10. The fiber construction (1) of claim 1, wherein said at least one fabric interface (30) is unnoticeable when the fiber construction (1) is in a relaxed state.

11. A flexible interface (1) comprising:
15 a conductive material (10) cooperating with a non-conductive material (20) to form one or more electronic interfaces (30),

wherein said non-conductive material (20) is an elastomeric material that cooperates with said one or more electronic interfaces (30) to provide elasticity or flexibility thereto.

20 12. The flexible interface (1) of claim 11, wherein said one or more

electronic interfaces (30) are revealed and/or can be accessed when in a stretched or extended state.

13. The flexible interface (1) of claim 12, wherein said one or more electronic interfaces (30) are hidden or substantially hidden when the in a relaxed
5 state.

14. The flexible interface (1) of claim 11, wherein said one or more electronic interfaces (30) form part of an abstract or decorative pattern.

15. The flexible interface (1) of claim 11, wherein said one or more electronic interfaces (30) are integral to an abstract or decorative pattern.

10 16. The flexible interface of claim 11, wherein said elastomeric material (20) is selected from one or more of the following: lycra, spandex, neoprene, polyester, and/or any rubber extruded material, or any combination of the same.

17. A method for forming a fabric interface comprising the steps of:
(a) fashioning one or more conductive fibers (10) and one or more non-
15 conductive fibers (20) into a flexible fiber construction (1);

(b) stretching said fiber construction (1) to an extended state; and

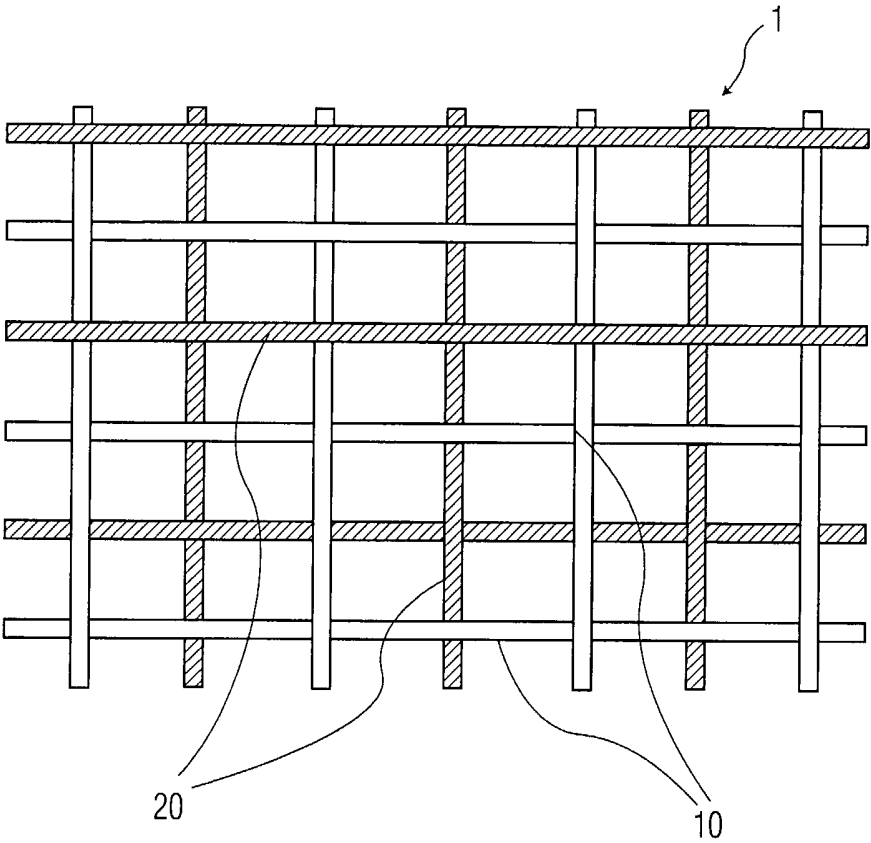
(c) patterning interface graphics (40) on said stretched fiber construction.

18. The method of claim 17, wherein said interface graphics are suitable for user interaction.

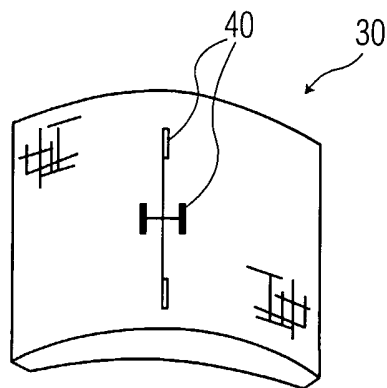
19. The method of claim 17, wherein said fabric interface is suitable for cooperating with various types of wearable electronics and/or similar devices.

20. The method of claim 17, wherein said interface graphics are either part of, or integral with, an abstract or decorative pattern associated with a

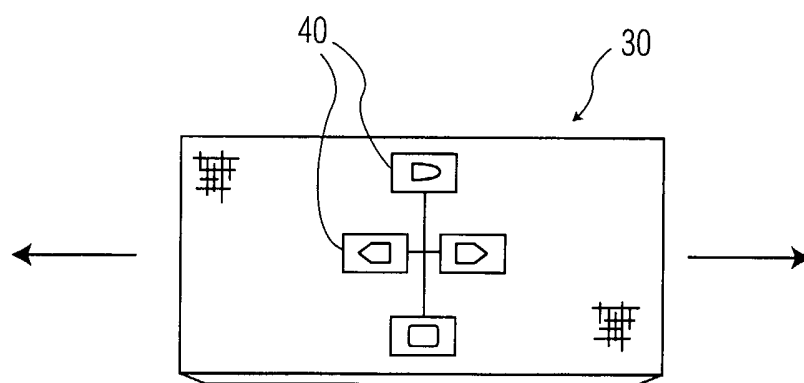
5 garment.



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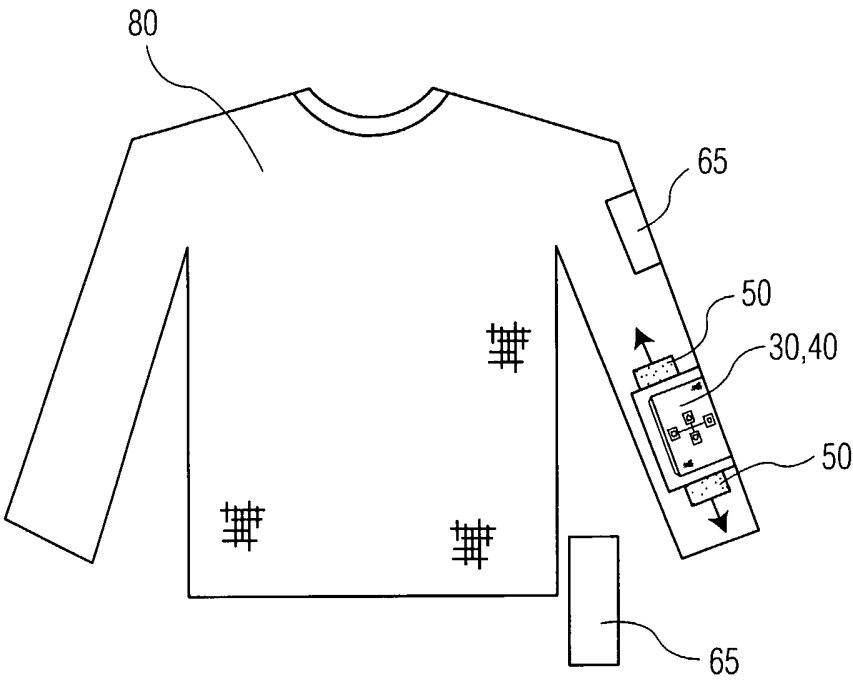


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