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(71) Applicant(s):
Curious Chip Limited
8 Kelvinside Gardens, GLASGOW, G20 6BB, United Kingdom

(72) Inventor(s):
Jason Frame
Sukhvir Dhillon

(74) Agent and/or Address for Service:
Creation IP Limited
Hillington Park Innovation Centre, 1 Ainslie Road, GLASGOW, G52 4RU, United Kingdom

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(54) Title of the Invention: **Electronic Breadboard Switching Device**
Abstract Title: **Electronic breadboard switching device**

(57) An electronic breadboard switching device 10 comprises an input/output bus connector 30 for connection to a bus connector of a processing device for the communication of power, data and/or control signals to and/or from the processing device. The switching further includes an array of conductive holes 40, 45, 50, 55 to allow insertion and electrical connection of wires 90, 92, 94, 96 for electrical connection to conductive holes in an electronic breadboard 20. Electrical connectors 1-12 and 13-24 electrically connect the input bus connector 30 to the array of conductive holes, and a switch arrangement 110 serves to disconnect the electrical connections carrying power, data and/or control signals between the input bus connector and the array of conductive holes. The switch may be manually operated by a user of the electronic breadboard switching device.

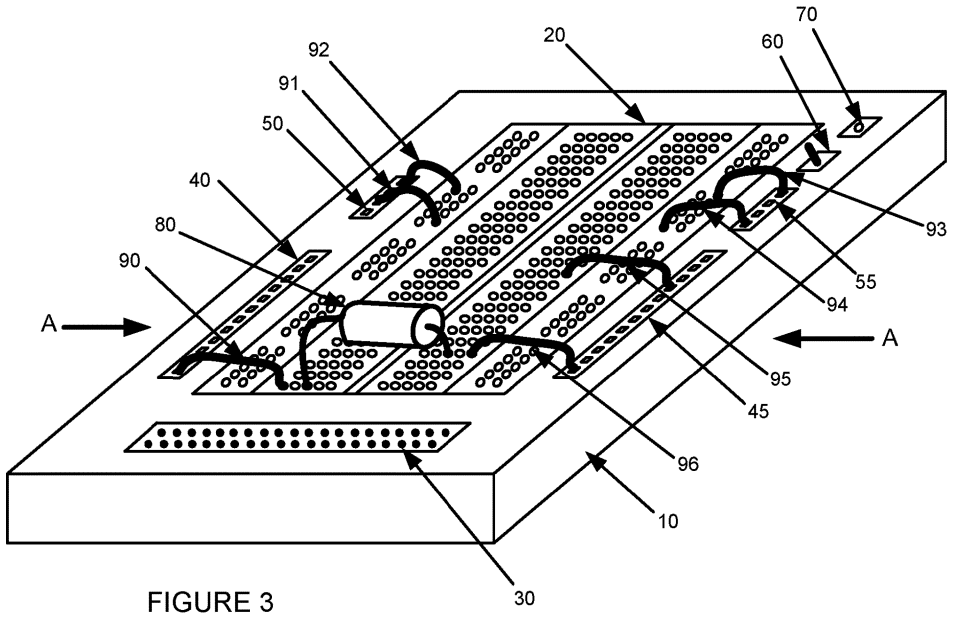

FIGURE 3

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This print incorporates corrections made under Section 117(1) of the Patents Act 1977.

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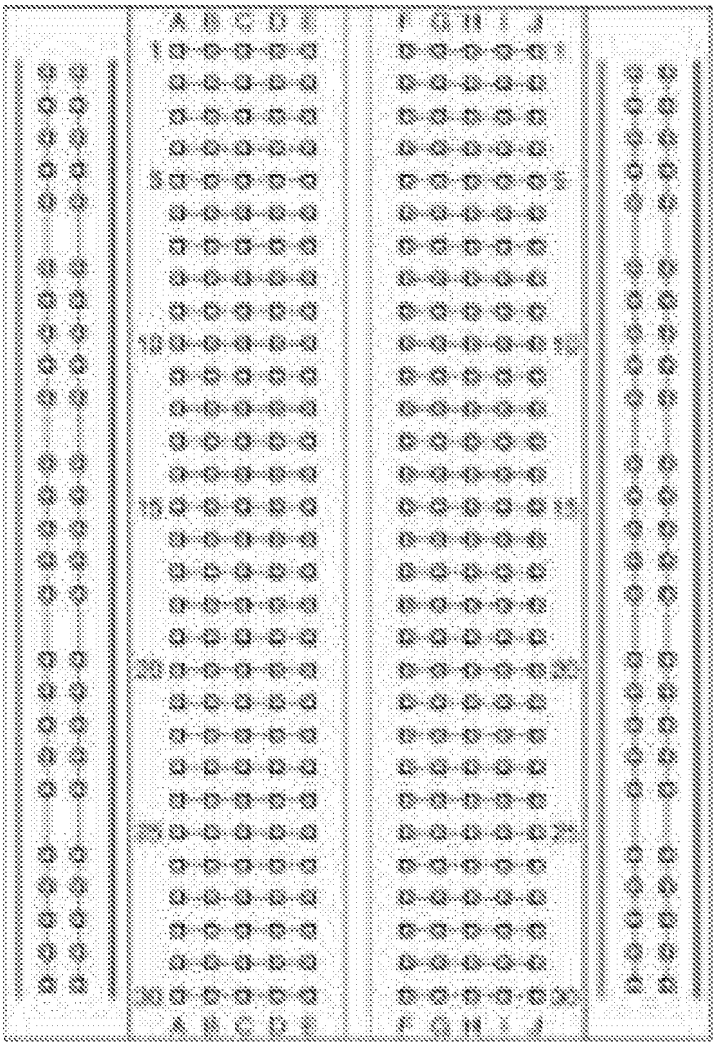

FIGURE 1

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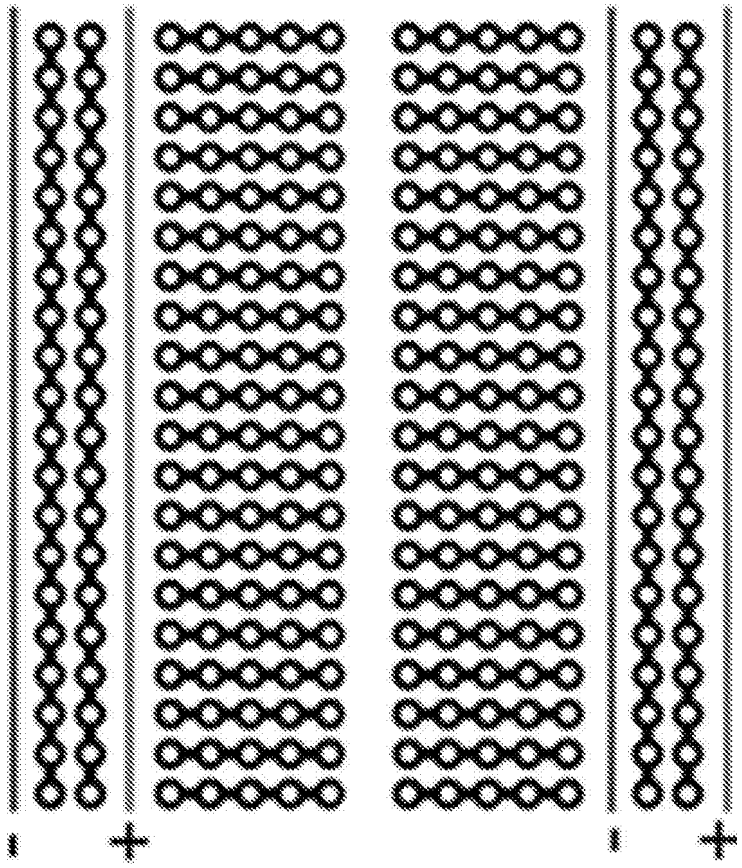

FIGURE 2

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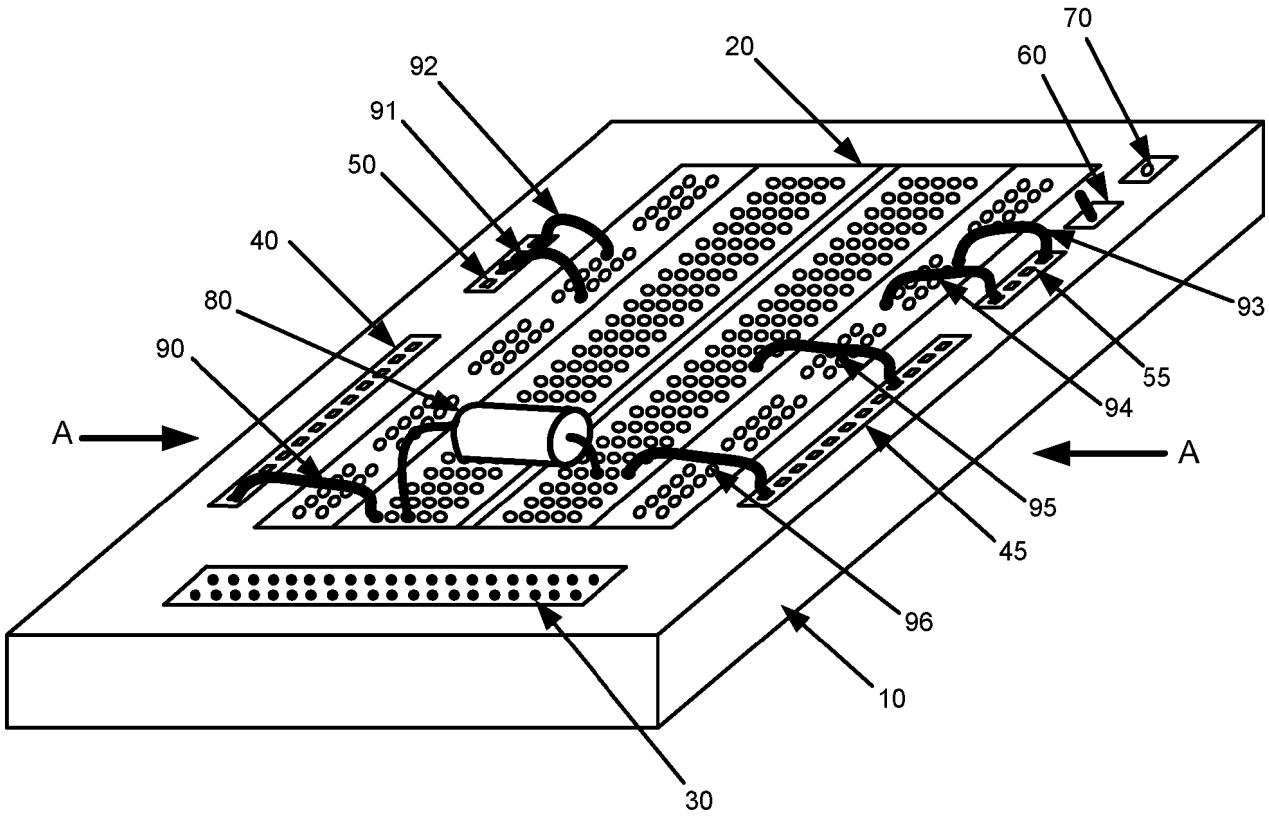

FIGURE 3

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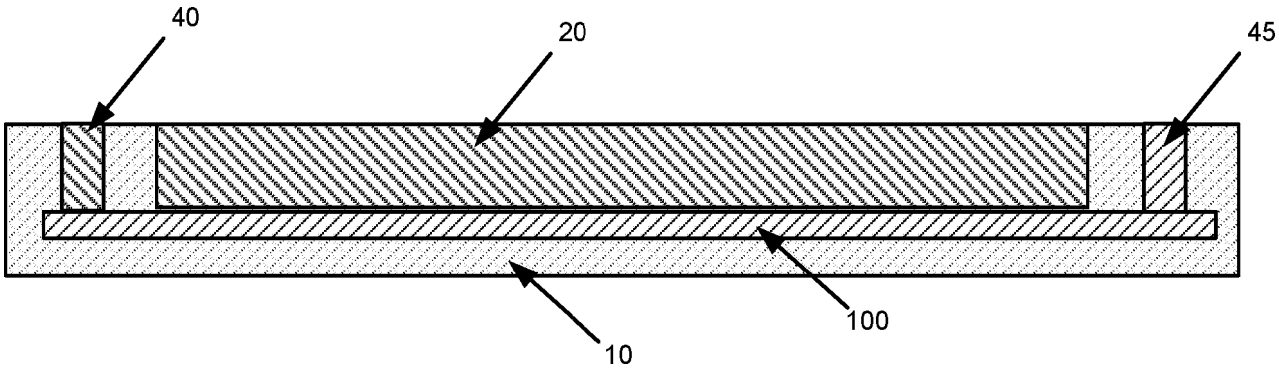

FIGURE 4

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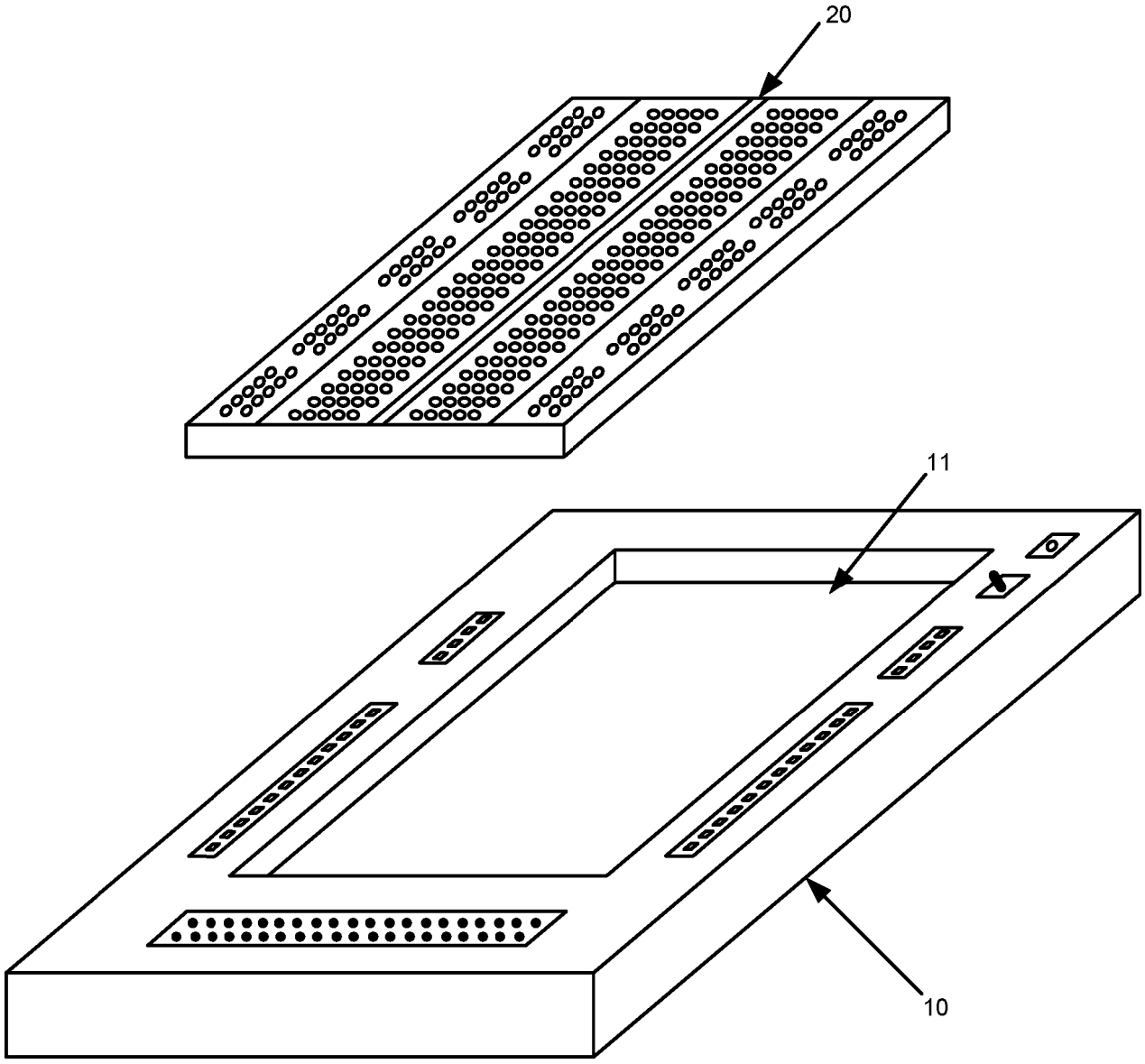

FIGURE 5

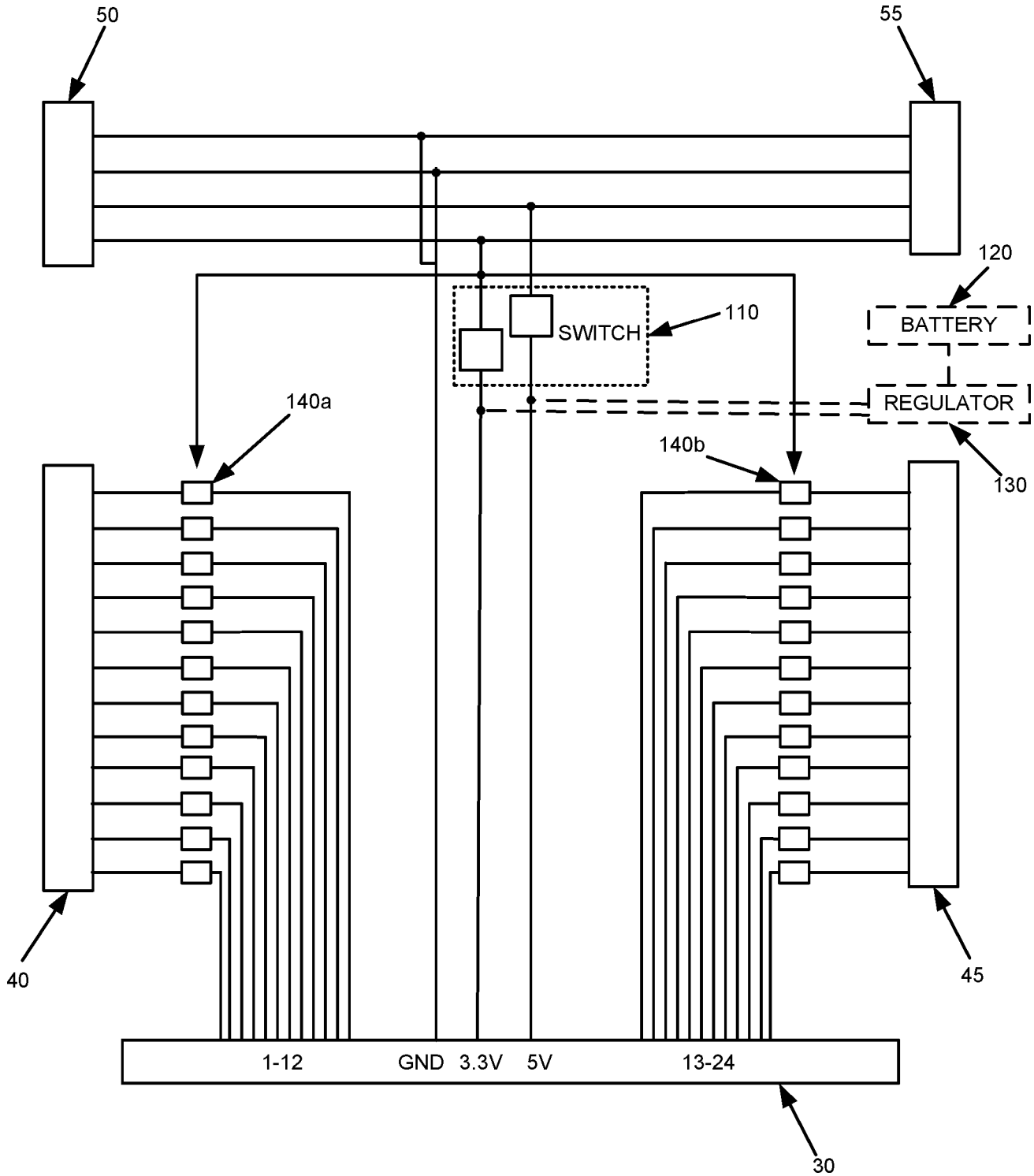

FIGURE 6

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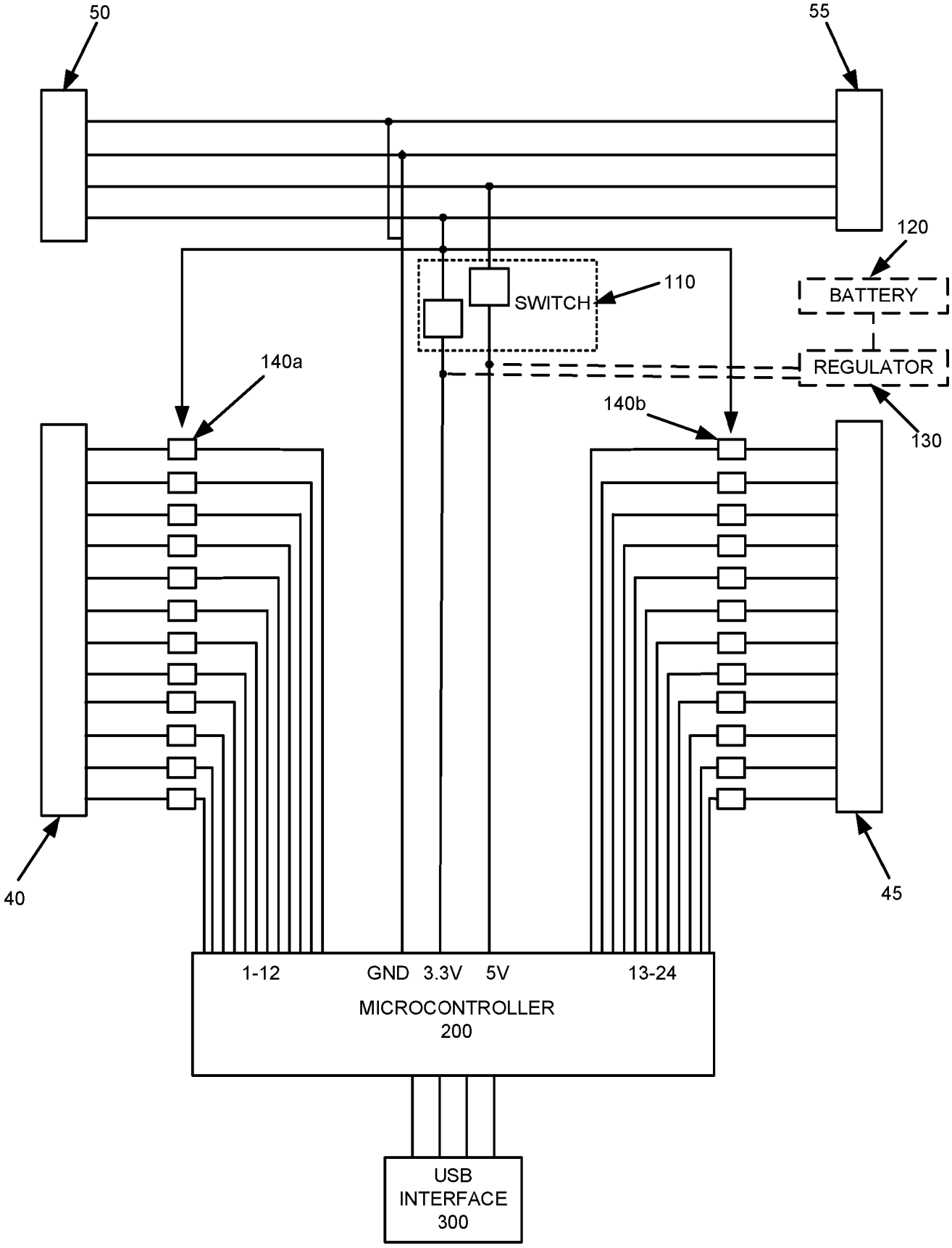

FIGURE 7

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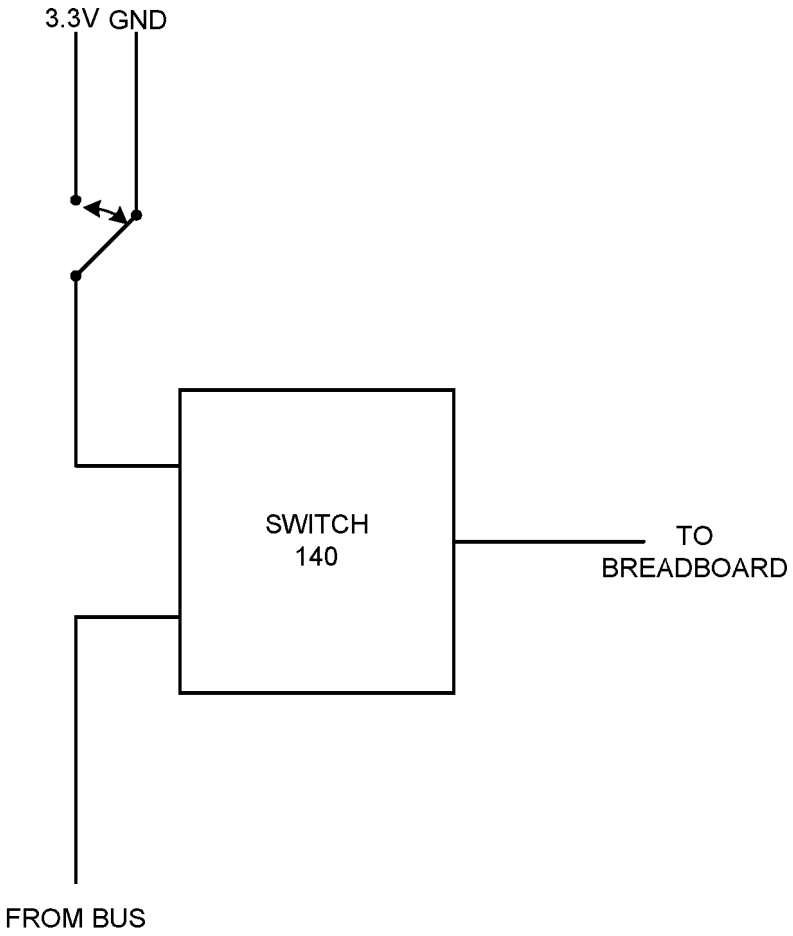

FIGURE 8

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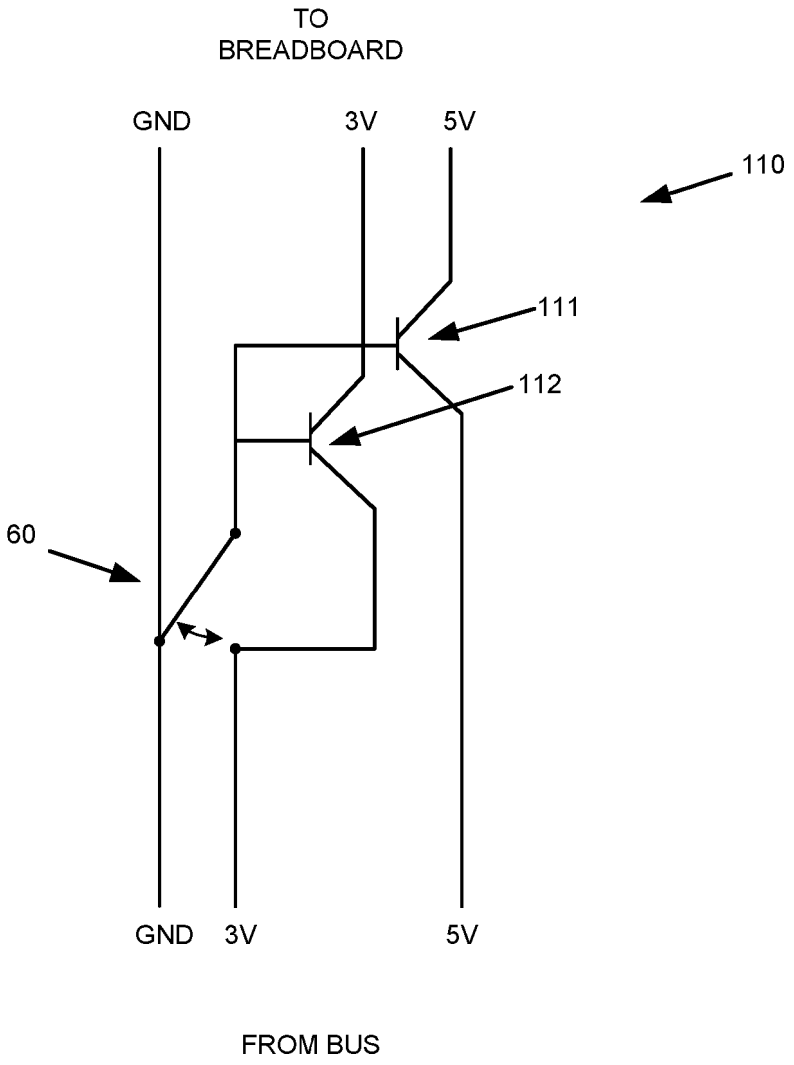

FIGURE 9

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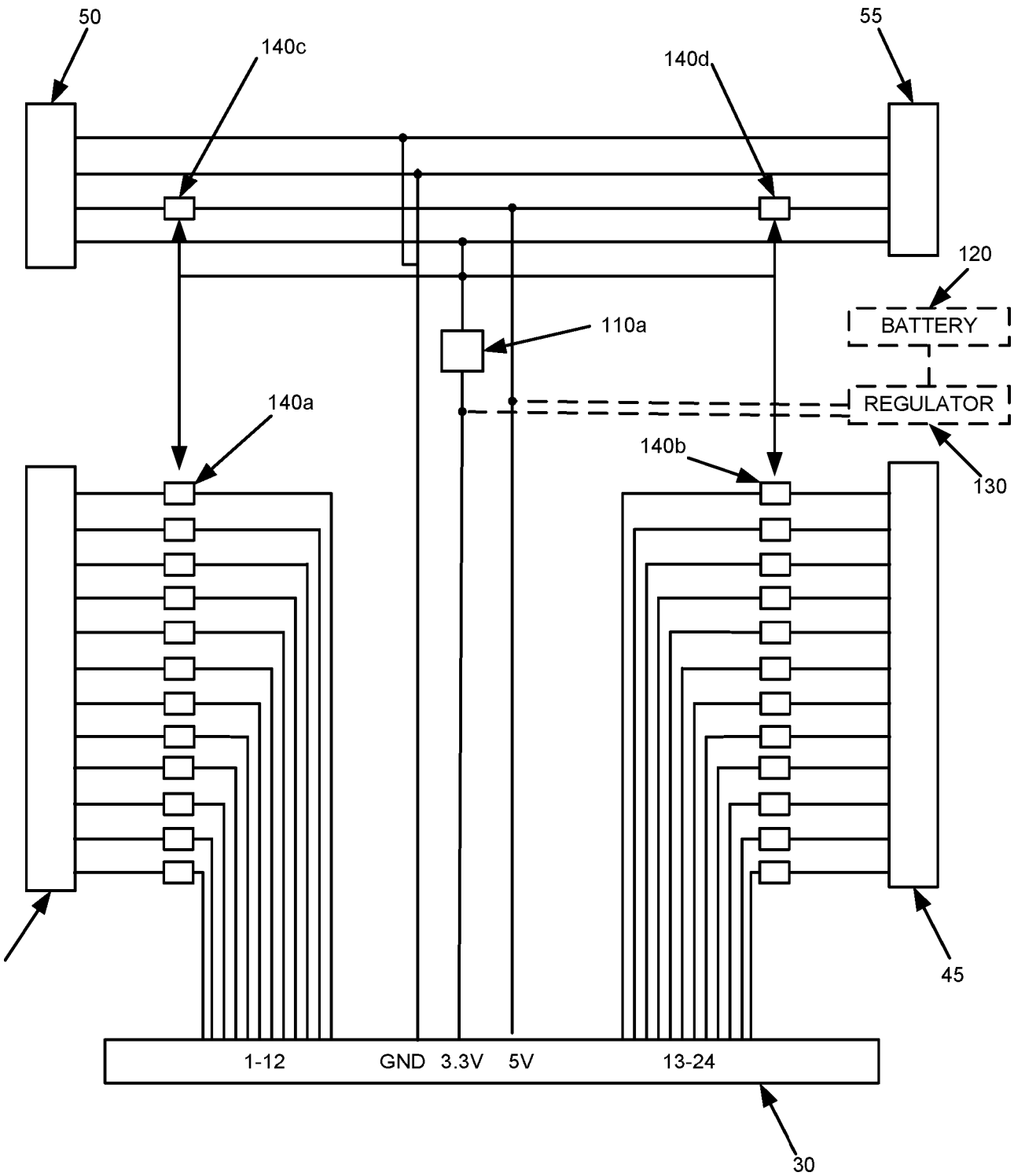

FIGURE 10

ELECTRONIC BREADBOARD SWITCHING DEVICE

FIELD OF THE INVENTION

[0001] The present invention relates to an electronic breadboard switching device.

BACKGROUND INFORMATION

[0002] A breadboard is a solderless device shaped as a board for testing temporary prototype electronics and test circuit designs. Most electronic components in electronic circuits can be interconnected by inserting their leads or terminals into the holes and then making connections through wires where appropriate. A plan view of a typical breadboard is illustrated in figure 1. The breadboard has strips of metal underneath the board that connect the holes on the top of the board. The metal strips underneath the board are laid out as shown in figure 2. Note that the top and bottom rows of holes are connected horizontally and split in the middle, while the remaining holes are connected vertically. Note how all holes in the selected row are connected together, as are the holes in each column. A breadboard will often have labels printed labelling the columns in the central area with letters and the rows with numbers. The central areas are the areas in which the electronic components are connected to form the circuit. The columns on either side are typically used as power and ground rails.

[0003] A breadboard can hence be used for prototyping and teaching electronic circuit design. When the designed circuit is intended to be interfaced with a processing device, such as a handheld device or computer (e.g. a mobile phone, laptop computer, tablet computer etc), an input/output bus interface is required to input signals and power to the circuit on the breadboard and output signals from the circuit on the breadboard to the processing device. Once such processing device that is widely used for teaching is the Raspberry Pi™. The Raspberry Pi™ is a is a low cost, credit-card sized computer that plugs into a computer monitor or TV and uses a standard keyboard and mouse. It is a device that enables people of to explore computing, and to learn how to program in languages like Scratch and Python. The Raspberry Pi™ uses a 40 pin connector for input/output connections. Hence, a type of input/output bus interface for a breadboard can comprise a 40 pin connector.

[0004] When building and testing an electronic circuit on a breadboard connected to an electronic device, it if often necessary or desirable to modify the circuit connections on the breadboard. In order to avoid electrical shorting and damage to electrical components, it is desirable or necessary to disconnect at least the power to the breadboard. When the input/output

connection to the breadboard comprises a plurality of signals and power lines, it is not easy to isolate each input/output connection. Hence, usually the user will have to disconnect the bus connector cable from the input/output bus connector on the breadboard. This is inconvenient and can be tricky or fiddly for parallel connectors such as a 40 pin connector.

SUMMARY OF THE INVENTION

[0005] The present invention provides an electronic breadboard switching device comprising an input/output bus connector for connection to a bus connector for the communication of power, data and/or control signals to and/or from a processing device, an array of conductive holes to allow insertion and electrical connection of wires for electrical connection of the wires to conductive holes in an electronic breadboard, electrical connectors electrically connecting the input/output bus connector to the array of conductive holes, and a switch arrangement operable by a user of the electronic breadboard switching device to disconnect the electrical connections carrying power, data and/or control signals between the input/output bus connector and the array of conductive holes.

BRIEF DESCRIPTION OF THE DRAWINGS

[0006] Figure 1 is a schematic diagram illustrating a plan view of a breadboard of the prior art;

[0007] Figure 2 is a schematic diagram of a rear view of a breadboard of the prior art of the embodiment of figure 1;

[0008] Figure 3 is a schematic perspective diagram of a breadboard switching device according to an embodiment;

[0009] Figure 4 is a cross sectional view through AA of the breadboard of figure 3 according to an embodiment;

[0010] Figure 5 is a schematic perspective diagram of a breadboard switching device according to another embodiment;

[0011] Figure 6 is a schematic diagram illustrating the electrical connections and components of a breadboard switching device according to an embodiment;

[0012] Figure 7 is a schematic diagram illustrating the electrical connections and components of a breadboard switching device according to another embodiment;

[0013] Figure 8 is a schematic diagram illustrating a microswitch of a breadboard switching device according to an embodiment;

[0014] Figure 9 is a schematic diagram illustrating a power switch arrangement of a breadboard switching device according to an embodiment; and

[0015] Figure 10 is a schematic diagram illustrating the electrical connections and components of a breadboard switching device according to a further embodiment

DETAILED DESCRIPTION

[0016] In the following detailed description, reference is made to the accompanying drawings that form a part hereof, and in which is shown by way of illustration specific embodiments in which the inventive subject matter may be practiced. These embodiments are described in sufficient detail to enable those skilled in the art to practice them, and it is to be understood that other embodiments may be utilized, and that structural, logical, and electrical changes may be made without departing from the scope of the inventive subject matter. Such embodiments of the inventive subject matter may be referred to, individually and/or collectively, herein by the term "invention" merely for convenience and without intending to voluntarily limit the scope of this application to any single invention or inventive concept if more than one is in fact disclosed.

[0017] The following description is, therefore, not to be taken in a limited sense, and the scope of the inventive subject matter is defined by the appended claims and their equivalents.

[0018] In the following embodiments, like components are labelled with like reference numerals.

[0019] A generalized embodiment comprises an electronic breadboard switching device comprising an input/output bus connector for connection to a bus connector for the communication of power, data and/or control signals to and/or from a processing device, an array of conductive holes to allow insertion and electrical connection of wires for electrical connection of the wires to conductive holes in an electronic breadboard, electrical connectors electrically connecting the input/output bus connector to the array of conductive holes, and a switch arrangement operable by a user of the electronic breadboard switching device to disconnect the electrical connections carrying power, data and/or control signals between the input/output bus connector and the array of conductive holes.

[0020] Hence, the electronic breadboard switching device provides a single switch isolation capability for a breadboard interfaced to a processing device to send and/or receive

multiple signals (data or control signals) and to receive power to operate electronic devices on the breadboard. The switch arrangement avoids the need to disconnect the bus connector from the processing device when reconfiguration of the electronic components on the breadboard are required. It also avoids the alternative requirement of disconnecting and reconnecting a number of connections on the breadboard to avoid short circuits or component damage during circuit reconfiguration.

[0021] The user operable switch arrangement can isolate all of the used signaling lines and power lines from the electronic device to the components on the breadboard by isolating the array of conductive holes that are used for making connections to the components on the breadboard. The earth connection or connections can be switched by the switching arrangement but need not be. Hence, a user can simply switch the switch to isolate a breadboard to allow the user to build or modify an electronic circuit with the connection to the processing unit still connected. This simplifies and reduced time for circuit building and redesign on the breadboard.

[0022] The switching arrangement can comprise an array of switches arranged to switch the electrical connections carrying power, data and/or control signals between the input/output bus connector and the array of conductive holes. Each switch can be adapted to switch to make a connection between a conductive hole and the input/output bus connector responsive to power applied to the switch from the input bus connector. A power switch arrangement can be responsive to user operation to disconnect power to the array of switches. This provides a simple arrangement for single user switch implementation of isolation of parallel electrical connections to the array of conductive holes.

[0023] The power switch arrangement can be connected between the input/output bus connector and one or more conductive holes and can be adapted to be responsive to user operation to disconnect power to the one or more conductive holes. Hence, the power switch can switch power to the array of switches, as well as switching power to a number of conductive holes.

[0024] An earth connection can be provided between the input/output bus connector and one of more conductive holes and the earth connection may not being switched by the switching arrangement. It may not be necessary to isolate the earth connection since this does not represents a risk during circuit building and reconfiguration on the breadboard.

[0025] The electronic breadboard switching device may include the electronic breadboard.

[0026] A housing can be provided, wherein the input/output bus connector, the array of conductive holes, the electrical connectors and the switch arrangement are arranged in the housing, and the electronic breadboard is held in or on the housing.

[0027] The housing may include a recess and the electronic breadboard is adapted to fit in the recess. The electronic breadboard has conductive holes on a surface, and the array of conductive holes can be arranged on a surface of the housing in a common plane with the conductive holes of the breadboard.

[0028] The conductive holes of the array of conductive holes can be arranged on a surface of the housing either side of a surface of the breadboard containing conductive holes. This enables easy access for connector wires to connect to electrical components in the breadboard to pass power or to send or receive signals from the conductive holes to the electronic components.

[0029] The breadboard can be integrated into the housing of it can be detachable and replaceable with alternative breadboards of different sizes. If the breadboard fits in a recess, the breadboard of the same size as the recess fill fit best. However, smaller sized breadboards can also fit in the recess.

[0030] The input/output bus connector can comprise a multipin or multihole connector, and the electrical connectors electrically can connect each pin or hole to each conductive hole of the array of conductive holes. For example, the input/output bus connector can comprise a 40 pin connector of the type for use with the Raspberry Pi™ as the computing device to provide a convenient environment for teaching programming, circuit design and interfacing to the electronic circuit.

[0031] The input/output bus connector can alternatively comprise a communications port and a microcontroller programmed to convert communications signals to and from an array of power, data and/or control signals. The electrical connectors are electrically adapted to connect the array of power, data and/or control signals to the array of conductive holes. Hence, in this embodiment, the communication to the processing device uses a communications protocol and the microcontroller is required to multiplex and demultiplex the signals between the plurality of electrical connections to the array of conductive holes and the communications communication protocol e.g. serial communications signals.

[0032] In embodiments, the communications port can comprise a generic remote control and programming interface that could be either wired (e.g. USB, ethernet, serial etc) or wireless (e.g. WiFi, Bluetooth, BLE).

[0033] The microcontroller can programmable over the communications port to allow a user to program the form of the communication between the processing device and the circuit built on the breadboard.

[0034] The microcontroller can be programmed to operate independently of a connected processing device to communicate power, data and/or control signals to and/or from the processing device. Alternatively. the microcontroller can be programmed to operate in cooperation with a connected processing device to communicate power, data and/or control signals to and/or from the processing device.

[0035] A power supply, such as a battery and a regulator, can be provided to the input/output bus connector to provide power in place of power from the input/output bus connector when the bus connector is disconnected from the input/output bus connector and the electronic breadboard switching device is disconnected from the processing device. This allows the electronic breadboard switching device and the breadboard to operate the circuit build on the breadboard away from and separate to the processing device. For example, the circuit built on the breadboard could be a simple form of a weather station, gathering and storing temperature and humidity measurements using sensors mounted on the breadboard. This circuit can be used outside for a period of time to gather measurements without being tied to the processing unit using the onboard power available from the electronic breadboard switching device. When the bus connector is connected to the input/output bus connector of the electronic breadboard switching device, the communication with the processing device can resume and data gathered can be uploaded to the processing device. In one example, the microcontroller used for controlling communications over an interface, such as USB, ethernet, WiFi, Bluetooth etc, can be programmed to operate autonomously from code downloaded to it from a remote processing device (e.g. mobile device, computer or tablet) using an on-board power supply to power the microcontroller and the other circuit components on the breadboard. Also, or alternatively, the microcontroller can be directly controller by the remote processing device.

[0036] Specific embodiments will now be described with reference to the drawings.

[0037] Figure 3 is a schematic perspective diagram of a breadboard switching device according to an embodiment.

[0038] A housing 10 houses the components comprising a breadboard 20, a parallel 40 pin input/output bus connector 30, and an array of conductive holes 40, 45, 50, and 55 arranged in a symmetric arrangement either side of the breadboard 20. The array of conductive holes 40,

45, 50, and 55 lie on a face of the housing 10 that is coplanar with conductive holes provided in the breadboard 20. The parallel 40 pin input/output bus connector 30 is also provided on the same face of the housing 10. The array of conductive holes 40, 45, 50, and 55 are separated into a first line 40 of 12 signal conductive holes for connection to signaling lines 1-12 on the 40 pin input/output bus connector 30, and a second line 45 of 12 signal conductive holes for connection to signaling lines 13-24 on the 40 pin input/output bus connector 30. The first and second lines 40 and 45 of conductive holes are arranged symmetrically either side of the breadboard 20. The array of conductive holes 40, 45, 50, and 55 are further separated into a first set of power conductive holes 50 and a second set of power conductive holes 55 for connection to power lines on the 40 pin input/output bus connector 30. The first and second set of power conductive holes 50 and 55 are arranged symmetrically either side of the breadboard 20.

[0039] The face of the housing 10 also has a switch 60 in it. This is a user operable switch to isolate the array of conductive holes 40. 45, 50, and 55 from the pins of the 40 pin input/output bus connector 30. The face of the housing 10 is also provided with an LED 70 to indicate when the power is not isolated i.e. it light up when the power and signals to and from the input/output bus connector 30 are connected to the array of conductive holes 40, 45, 50, and 55 and it extinguishes when the power and signals to and from the input/output bus connector 30 are isolated from the array of conductive holes 40, 45, 50, and 55.

[0040] Figure 3 illustrates some wiring connectors 90 to 96 connecting conductive holes 40, 45, 50 and 55 to conductive holes in the breadboard 20 and a resistor 80 connected in the conductive holes of the breadboard 20. These illustrate typical connectors that a user can make using wires and electric components to build an electronic circuit on the breadboard 20. In practice, far more complex wiring and circuit components will be used to build a circuit on the breadboard.

[0041] In the illustrated example, wires from the first set of power conductive holes 50 and a second set of power conductive holes 55 will connect to the outer vertically connected columns of conductive holes in the breadboard to provide power and earth rails for the circuit to be built on the breadboard. The inner rows of conductive holes of the breadboard can be connected to the signal to or from the conductive holes of the first and second lines 40 and 45. For example, in figure 3 the resistor 80 is connected between a connection from signal line 1 (hole 1) on the left hand side to signal line 13 (hole 13 – the first of 13-24) on the right hand side.

[0042] In this example, the breadboard 20 can be an integral part of the housing 10, it can be manufactured separately and fixed in the housing 10, or it could be removable, or detachable.

[0043] Figure 4 is a cross sectional view through AA of the breadboard of figure 3 according to an embodiment.

[0044] The housing 10 encloses the components such that the breadboard 20 lies within the housing 10 in a recess so that a face of the breadboard 20 having conductive pins is flush with a face of the housing around an outer perimeter of the breadboard 20. In the outer perimeter of the housing, lie the array of conductive holes illustrated by the first and second lines 40 and 45 in figure 4. A printed circuit board (PCB) 100 is provided in the housing 10 and mounts carrying the array of conductive holes 40, 45, 50 and 55 are mounted onto the PCB 100. The PCB can carry all of the electrical connections and components as will be illustrated in figures 6 to 10 herein after. The PCB 10 can also act as the base of the recess in which the breadboard sits in the housing 10 since it provides a convenient flat surface for the base of the breadboard 20 to rest on.

[0045] Figure 5 is a schematic perspective diagram of a breadboard switching device according to another embodiment.

[0046] In this embodiment, the breadboard 20 is detachable or removable from a recess 11 in the housing 10. In this embodiment, the breadboard is the same size as the recess and sits tightly in it to provide a configuration that looks like the arrangement of figure 3 in use. In this embodiment, the breadboard 20 can be replaced with any breadboard that is the same size or smaller. Of course, a smaller breadboard will sit in the recess 11 with some wasted space around it, but this does allow a range of breadboards to be used.

[0047] Figure 6 is a schematic diagram illustrating the electrical connections and components of a breadboard switching device according to an embodiment.

[0048] In this embodiment, the 40 pin parallel input/output bus connector 30 has signaling pins 1-24 and a ground line, a 5V power line and a 3.3V power line. This is just one example of a set of parallel power, data and/or control lines. The signals lines 1-12 are connected by electrical connections to the first line 40 of the array of conductive holes via a set of micro switches 140a and the signals lines 13-24 are connected by electrical connections to the second line 45 of the array of conductive holes via a set of micro switches 140b. The ground connection is connected straight to two ground pins in both the first and second set of power conductive holes 50 and 55. The 3.V power line and the 5V power line are both input to

respective switch components of a switch arrangement 110, with the outputs of the respective switch components going to third and fourth pins of the first and second set of power conductive holes 50 and 55. Also, the output of the switch component for the 3.3V power line is used to connect to and switch the micro switches 140a and 140b. The output of the switch arrangement for the 3.3V power line or the 5V power line can be used to power the LED 70 (not shown in figure 6). The switch 60 in figure 3 is part of the switch arrangement 110.

[0049] Hence, in operation, the operation of the switch arrangement 110 will cause 3.3V and 5V power to be applied to the third and fourth pins of the first and second set of power conductive holes 50 and 55. Also, the 3.3V power will be applied to the micro switches 140a and 140b to cause the switches to open to complete the connections between the conductive holes of the first and second lines 40 and 45 of the array of conductive holes and the pins of the input/output bus connector 30. In this way, the switching of the power lines also simultaneously switches the signal lines to provide for a single switched isolation arrangement.

[0050] In figure 6, shown in dotted lines are an optional battery 120 and a voltage regulator 130 comprising an onboard power supply for the breadboard switching device. The regulator outputs regulated power at 3.3V and 5V to the power lines that connect back to the input/output bus connector 30 on the input/output bus connector 30 side of the switch arrangement 110 to provide power when the bus connected connecting the input/output bus connector 30 to a processing unit is disconnected. This enables the breadboard switching device to operate "offline" in a portable mode. In this mode, any circuit build on the breadboard can operate using the power supply 120 and 130. Of course, the circuit cannot communicate with the processing device, but it can perform local processing operations such as gathering weather data as discussed above.

[0051] The embodiment of figure 6 is suitable for use with a 40 pin connector commonly used with a Raspberry Pi™ for example.

[0052] Figure 7 is a schematic diagram illustrating the electrical connections and components of a breadboard switching device according to another embodiment.

[0053] This embodiment has the same circuitry as described with reference to figure 6, except in this embodiment, the 40 pin parallel connector input/output bus connector 30 is replaces with a microcontroller 200 and a USB interface or port 300. The microcontroller 200 executes code (firmware) to convert signals communication between the breadboard switching device and the processing device using the USB protocol and the parallel connections on the circuit board to the signal conductive holes 40 and 45 and the power conductive pins 50 and

55. The conversion comprises a multiplexing and demultiplexing operation. A USB port is just one example of a communications port. The communications port can comprise any wired communication port such as USB, ethernet, RS232, serial etc, or any wireless communications port, such as WiFi, Bluetooth, BLE, or any other near field communication protocol.

[0054] The code executed by the microcontroller 200 can be preloaded or fixed, or it can be downloaded from the processing device over the USB connection. The micro controller 200 can operate independently of the processing device to perform the signaling conversion or it can operate in cooperation with the processing unit by signaling between the microcontroller 200 and the processing unit over the USB connection. Further, the microcontroller can be programmed to perform more functions than simple communications control in order to control functions on or related to electrical components on the breadboard. If the breadboard switching device has an on-board power supply, the microcontroller can function to work with the electronic components on the breadboard to perform independent processing that can later be synchronized to a remote processing device when communications are reconnected.

[0055] If the communications port is a wireless port, an on-board power supply if of course required to power the microcontroller and the electrical components on the breadboard.

[0056] Figure 8 is a schematic diagram illustrating a microswitch of a breadboard switching device according to an embodiment.

[0057] The switch 140 illustrated in figure 8 comprises a microswitch used as any of the array of switches 140a or 140b. The switching operation is controlled by the switching of the switch arrangement 110 between ground and 3.3V. When the switch 140 receives the 3.3V, signaling between the bus connector and the breadboard is possible.

[0058] Figure 9 is a schematic diagram illustrating a power switch arrangement 110 of a breadboard switching device according to an embodiment.

[0059] In this embodiment, the power switching arrangement 110 to switch the power of both the 3.3V and the 5V simultaneously comprises the user operable switch 60 which switches the 3.3V power to drive the gates of two transistors 111 and 112 to switch the power on for the 3.3V and 5V lines.

[0060] In alternative embodiments, the switching arrangement 110 can comprise a two-pole switch or a relay for example.

[0061] Figure 10 is a schematic diagram illustrating the electrical connections and components of a breadboard switching device according to a further embodiment.

[0062] This embodiment is similar to the embodiment of figure 6 except that the switching arrangement now comprises a single switch 110a to only switch power on the 3.3V power line. Switching of the 5V power line is achieved by two microswitches 140c and 140d connected to respective conductive pins of the first and second power conductive pins 50 and 55. The opening of the microswitches 104c and 140d is controlled by power from the 3.3V power line in the same manner as is used to control the opening of the micro switches 140a and 140b for control of the signals (data or control signals). The micro switches 140c and 140d may need to be different switch types to the micro switches 140a and 140b since these switches need to switch power and not signals. Further, although two microswitches 140cand 140d are illustrated in figure 10 for symmetry, only one microswitch need be used to switch the 5V power line at the point before it bifurcates to the connections to respective conductive pins of the first and second power conductive pins 50 and 55.

[0063] One aspect provides a carrier medium or computer-readable or processor medium, such as a non-transient storage medium storing code for execution by the microcontroller to carry out the conversion process, or a transient medium carrying processor executable code for execution by the microcontroller to carry out the conversion process. Embodiments can be implemented in programmable digital logic that implements computer code. The code can be supplied to the programmable logic, such as a processor or microprocessor, on a carrier medium. One such embodiment of a carrier medium is a transient medium i.e. a signal such as an electrical, electromagnetic, acoustic, magnetic, or optical signal. Another form of carrier medium is a non-transitory storage medium that stores the code, such as a solid-state memory, magnetic media (hard disk drive), or optical media (Compact disc (CD) or digital versatile disc (DVD)).

[0064] It will be readily understood to those skilled in the art that various other changes in the details, material, and arrangements of the parts and method stages which have been described and illustrated in order to explain the nature of the inventive subject matter may be made without departing from the principles and scope of the inventive subject matter as expressed in the subjoined claims.

[0065] Various changes in the details, material, and arrangements of the parts and method stages which have been described and illustrated in order to explain the nature of the inventive subject matter may be made without departing from the principles and scope of the inventive subject matter as expressed in the subjoined claims.

CLAIMS

1. An electronic breadboard switching device, the device comprising:

an input/output bus connector for connection to a bus connector for the communication of power, data and/or control signals to and/or from a processing device;

an array of conductive holes to allow insertion and electrical connection of wires for electrical connection of the wires to conductive holes in an electronic breadboard;

electrical connectors electrically connecting the input/output bus connector to the array of conductive holes; and

a switch arrangement operable by a user of the electronic breadboard switching device to disconnect the electrical connections carrying power, data and/or control signals between the input/output bus connector and the array of conductive holes.

2. An electronic breadboard switching device according to claim 1, wherein the switching arrangement comprises an array of switches arranged to switch the electrical connections carrying power, data and/or control signals between the input/output bus connector and the array of conductive holes, each switch adapted to switch to make a connection between a conductive hole and the input/output bus connector responsive to power applied to the switch from the input bus connector; and a power switch arrangement responsive to user operation to disconnect power to the array of switches.

3. An electronic breadboard switching device according to claim 2, wherein the power switch arrangement is connected between the input/output bus connector and one or more conductive holes and is adapted to be responsive to user operation to disconnect power to the one or more conductive holes.

4. An electronic breadboard switching device according to any preceding claim, wherein an earth connection is provided between the input/output bus connector and one of more conductive holes, the earth connection not being switched by the switching arrangement.

5. An electronic breadboard switching device according to any preceding claim, including the electronic breadboard.

6. An electronic breadboard switching device according to claim 5, including a housing, wherein the input/output bus connector, the array of conductive holes, the electrical connectors and the switch arrangement are arranged in the housing, and the electronic breadboard is held in or on the housing.

7. An electronic breadboard switching device according to claim 6, wherein the housing includes a recess and the electronic breadboard is adapted to fit in the recess.

8. An electronic breadboard switching device according to claim 7, wherein the electronic breadboard has conductive holes on a surface, and the array of conductive holes are arranged on a surface of the housing in a common plane with the conductive holes of the breadboard.

9. An electronic breadboard switching device according to any one of claims 6 to 8, wherein the conductive holes of the array of conductive holes are arranged on a surface of the housing either side of a surface of the breadboard containing conductive holes.

10. An electronic breadboard switching device according to any one of claims 6 to 9, wherein the breadboard is integrated in the housing.

11. An electronic breadboard switching device according to any one of claims 5 to 10, wherein the electronic breadboard is detachable.

12. An electronic breadboard switching device according to preceding claim, wherein the input/output bus connector comprises a multipin or multihole connector, and the electrical connectors electrically connect each pin or hole to each conductive hole of the array of conductive holes.

13. An electronic breadboard switching device according to any one of claims 1 to 11, wherein the input/output bus connector comprises a communications port and a microcontroller programmed to convert communications signals to and from an array of power, data and/or control signals, the electrical connectors electrically adapted to connect the array of power, data and/or control signals to the array of conductive holes.

14. An electronic breadboard switching device according to claim 13, wherein the microcontroller is programmable over the communications port.

15. An electronic breadboard switching device according to claim 13 or claim 14, wherein the microcontroller is programmed to operate independently of a connected processing device to communicate power, data and/or control signals to and/or from the processing device.

16. An electronic breadboard switching device according to claim 13 or claim 14, wherein the microcontroller is programmed to operate in cooperation with a connected processing device to communicate power, data and/or control signals to and/or from the processing device.

17. An electronic breadboard switching device according to any preceding claim, including a power supply to the input/output bus connector to provide power in place of power from the input/output bus connector when the bus connector is disconnected from the input/output bus connector and the electronic breadboard switching device is disconnected from the processing device.

18. An electronic breadboard switching device according to claim 17, wherein the power supply comprises a battery and a regulator.

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Claims searched:	1-18	**Date of search:**	16 November 2018

Patents Act 1977: Search Report under Section 17

Documents considered to be relevant:

Category	Relevant to claims	Identity of document and passage or figure of particular relevance
A	-	WO2018/084335 A1 (INNOTEMS) see whole document
A	-	KR1020110062333 A (HIROSCI) see figures, and also WPI Abstract Accession No. 2011-H77061
A	-	WO2017/113056 A1 (SHENZHEN A&E INTELLIGENT TECH) see figures and abstract

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