Title: IMPACT INTERFACE SYSTEM

Abstract: An interface comprising a surface associated with at least two switches, the switches being operable responsive to impacts on at least a portion of the surface, and feedback prevention means arranged such that when at least one of the switches is closed, flow of current through the closed switch to at least one other switch is prevented.
Impact Interface System

Field of the Invention
The present invention relates to a human computer interface and particularly a human computer interface for determining physical impacts. The interface may be used in computer games or the like.

Background to the Invention
Human computer interfaces and controllers are available that provide an enriched user experience beyond that provided by traditional keyboard or joystick input devices. One example is the Nintendo\textsuperscript{RTM} Wii\textsuperscript{RTM} system, which provides a motion based controller that monitors the position, orientation and motion of the controller. The user performs motions and gestures by moving the controller through the air. Such motions are detected and recorded by the system using a variety of technologies such as IR beam tracking and accelerometers.

Although controllers that detect motions through the air, such as the Wii\textsuperscript{RTM} controller, provide a more involved gaming experience and allow a greater degree of physical exertion than traditional computer input devices, they may not provide the intense exertion experience or physical feedback associated with events that involve an impact.

Summary of Invention
According to a first aspect of the present invention there is provided an interface comprising a surface associated with at least two switches, the switches being operable responsive to impacts on at least a portion of the surface, and feedback prevention means arranged such that when at least one of the switches is closed, flow of current through the closed switch to at least one other switch is prevented.

The switches may be operable between at least an open configuration and a closed configuration.

The interface may comprise means for determining whether at least one of the switches is in an open or closed configuration. The feedback prevention means may be arranged to prevent the configuration of at least one of the switches
affecting the ability of the means for determining to determine the configuration of at least one other switch.

The feedback prevention means may be arranged to selectively block current flowing in at least one direction through the at least one switch. The at least one switch may comprise at least an input terminal and an output terminal. The feedback prevention means may be arranged to prevent flow of current through the at least one switch from the output terminal to the input terminal when the at least one switch is in the closed position.

The switches may be arranged in an array. The array may comprise a grid.

The switches may be arranged into at least one first subset and/or at least one second subset. Each first subset may comprise one or more switches, wherein the input terminal of each switch in the subset is electrically connected. Each first subset may comprise a column of switches.

Each second subset may comprise one or more switches, wherein the output terminal of each switch in the subset is electrically connected. Each second subset may comprise a row of switches.

Each switch may be associated with a first and a second subset.

The interface may comprise a controller adapted to apply electrical signals to the switch input terminals. The controller may be adapted to selectively apply electrical signals to input terminals of switches in selected subsets or columns. The controller may be adapted to sequentially apply electrical signals to respective first subsets.

The controller may comprise the means for determining whether at least one of the switches is in an open or closed configuration. The controller may be adapted to monitor the output terminals for electrical signals. The controller may be adapted to simultaneously monitor the electrically connected output of each row of switches.

By applying a signal to a selected column of switches and simultaneously detecting which of the output rows the signal is received on, the controller is adapted to
determine which switches on that column have been closed by an impact. As a signal is applied sequentially to each column, one column at a time, any closed switch in the entire matrix of switches can be identified.

The feedback prevention means may be arranged to prevent flow of current from the electrically connected output terminals of at least one row or second subset of switches to the electrically connected input terminals of at least one column or first subset of switches.

All of the switches may have an associated feedback prevention means.

The feedback prevention means may be a diode.

The diode may be located between the input or output terminal of the switch and the respective electrical connector. The diode may be arranged to allow flow of current from the electrical connection associated with the input terminal to the electrical connection associated with the output terminal. The diode may be arranged to block flow of current through the switch from the electrical connection associated with the output terminal to the electrical connection associated with the input terminal.

By blocking flow of current through the switch in a closed position from the output connections to the input connections, the possibility cross-talk due to feedback of signals from shared output rows to the input columns when multiple switches are closed due to multiple impacts is eliminated. This allows the interface to be capable of accurately determining multiple simultaneous impact sites. Provision of a system that is capable of handling multiple simultaneous impacts results in a more realistic gaming experience and encourages a greater degree of physical exertion as it allows features such as full or partial body impacts, where an impact site covers a plurality of switches in the interface and/or simultaneous impacts from more than one limb, for example, simultaneous punching and kicking or punching with both arms. It also allows support for multiple players using the same interface.

At least part of the interface may be adapted to be resiliently compressible and/or deformable in response to an impact. By providing a resiliently deformable interface capable of receiving actual contact, and in particular impacts delivered with brute
force, and having a controlled resistance to the impacts, the system offers a much more intense physical exertion workout and a more immersive gaming experience than systems that operate using non-contact gestures.

The switches may be formed from a resiliently compressible insulator disposed between two switch layers, each switch layer at least partially comprising conductive material, such that, when the switch is in an open configuration, the two switch layers are separated by the compressible insulator. The compressible insulator may comprise through apertures, such that the two layers comprising conductive material may contact each other when the switch and thereby the insulator is compressed. The compressible insulator may be formed from foam.

The first switch layer may comprise at least one discrete panel of conductive material, each panel defining the area of one switch. The second switch layer may comprise at least one discrete panel of conductive material, each panel of conductive material of the second layer being arranged to cooperate with one or more panels of conductive material of the first layer in order to form at least one switch. The panels of the second layer may be rows or columns of conductive material.

The first and second layer may comprise discrete panels of conductive material affixed to an insulating backing sheet.

The conductive material may be a conductive fabric. The conductive fabric may be a rip-stop conductive fabric. By using rip-stop conductive fabric, the switches are more resistant to tearing or shredding caused by impacts than switches constructed using alternative conductive materials such as conventional conductive fabric or mylar.

The interface may comprise an outer stretch fabric layer. The outer surface of the stretch fabric layer may be white and/or retroreflective. The stretch fabric may cover the switches to thereby provide the surface for receiving impacts.

The interface may comprise a resiliently deformable backing layer, which may be a foam backing layer. The interface may be adapted to stand substantially vertically.
The rigidity of the padded backing and/or the foam separator may be selected to allow the interface to stand upright, with the surface for receiving impacts arranged generally perpendicularly to the floor without a supporting structure. By adapting the interface to stand upright from the floor, a user can easily access the entire impact surface of the interface without producing spurious or unintended impacts on the interface.

The interface may comprise at least one accelerometer. The accelerometer may be embedded in the insulator layer. The accelerometer may be arranged to be actutable by impacts to the surface of the interface. The accelerometer may be actutable by impacts to substantially any point of the interface surface. The accelerometer may be adapted to determine the force of impacts on the interface.

The switches may be adapted to be responsive to physical impacts and/or impacts applied with physical and/or brute force.

According to a second aspect of the present invention there is provided an interface comprising a surface associated with at least two switches, the switches being operable between at least an open configuration and a closed configuration responsive to impacts on at least a portion of the surface; the interface further comprising means for determining the configuration of at least one switch and feedback prevention means arranged to prevent the configuration of at least one of the switches affecting the ability of the means for determining to determine the configuration of at least one other switch.

According to a third aspect of the present invention is a system comprising a controller and at least one interface according to the first aspect.

The system may be a gaming system. The system may be a computer based system.

The system may further comprise at least one projector adapted to project an image onto the outer surface of at least one interface. The image may be an image of a user. The image may represent a silhouette of a user.
The system may comprise at least one image capture device, which may be a digital video camera. The video camera may be arranged to collect a video image of a user. The video image may be an image mask or silhouette image. The controller may be adapted to convert the image into an image mask or silhouette image.

The controller may comprise communications apparatus for communicating with at least one other system and/or interface. The at least one other system and/or interface may be a remote system and/or interface. The communications apparatus may operate in conjunction with a network.

The controller may be adapted to communicate with the interface and thereby determine the location of impacts on the outer surface of the interface. The controller may be adapted to receive a video image of an entity or user from at least one remote system. The controller may be adapted to project the video image of the entity or user onto the outer surface of the interface. The controller may be adapted to determine areas of the outer surface onto which the image of the entity or user is projected. The controller may be adapted to determine if the location of at least one impact on the outer surface corresponds to an area of the outer surface onto which the video image of the entity or user is projected.

According to a fourth aspect of the present invention is a computer program product, or carrier means containing a computer program product, arranged to implement the interface of the first aspect or the system of the second aspect.

**Description of the Drawings**

Various aspects of the invention will now be described by way of example only and with reference to the accompanying drawings of which:

- Figure 1 is a schematic of a game system;
- Figure 2 is a schematic of an interactive system for use with the game system of Figure 1;
- Figure 3 is an exploded view of the interface for use in the system of Figure 1;
- Figure 4 is a detail view of a layer of the interface of Figure 3; and
- Figure 5(a) is a circuit diagram for the interface of Figure 3.
Figure 5(b) is a detail view of the interface circuit of Figure 5(a);
Figure 6 is a schematic of a system controller for use with the system of Figure 1; and
Figures 7 and 8 are views of the system of Figure 1 in use.

**Specific Description**
The described embodiment has multiple interaction systems. Like components in each interaction system are provided with the same numeric reference with an indicator a or b to indicate the interaction system to which they belong. Reference numerals relating generally to like components in either of the interaction systems are provided without the indicator.

Figure 1 shows a game system 5. The game system 5 is provided with a system controller 10 in communication with first 15a and second 15b interaction systems. The first interaction system 15a is arranged for use by at least one first user 20a and the second interaction system 15b is arranged for use by at least one second user 20b. The first 15a and second 15b interaction systems may be located in a same room, or remotely located and in communication with each other over a network. In an alternative embodiment, each interaction system 15a, 15b is provided with a separate system controller, each system controller having at least some or all of the functionality of the primary system controller 10.

As shown in Figure 2, each interaction system 15 comprises an interface 25 for receiving and detecting impacts from the respective user 20, a video camera 30 arranged to collect image and positional data of the respective user 20, a projector 35 for projecting an image 40 onto a projection surface 45 of the interface 25, a microphone 50 for receiving sounds from the respective user 20 and a speaker system 55 for providing game audio and user sounds collected by the respective microphones 50.

As shown in Figure 3, the interface unit 25 comprises a white stretch fabric cover 60 enclosing an array of soft switches 65 arranged in front of foam backing 70. The stretch fabric cover 60 is adapted to be useable as a projection surface 45 for the projector 35. The fabric is selected to be robust and have elastic properties. By
using a stretch fabric, the outer projection surface 45 of the interface 25 is kept smooth and creases or folds that may distort the image 40 projected onto it are minimised. The stretch of the cover 60 fabric accommodates impacts, reducing the risk of tearing and allows the compressible layers enclosed by the fabric to provide a soft but controlled elastic deformation in response to an impact.

The interface unit 25 comprises a first switch layer 75 provided with squares 80 of conductive rip-stop fabric, as shown in Figure 4. Each square 80 of conductive fabric defines the area of a switch S1-S120 (as shown in Figure 5(a)). Each square 80 of conductive fabric acts as one contact of each switch S1-S120. The other contact of each switch S1-S120 is provided by a second switch layer 90 having rows 95 of conductive rip-stop fabric that span the entire width of the interface unit 25. Each square 80 of conductive fabric on the first layer 75 and each row 95 of conductive fabric on the second layer 90 is spaced apart and electrically isolated from the other squares 80/rows 95 by borders 100, 105 of insulating material. By providing an insulating border 100 around each of the conductive squares 80 of the switch array 65, each of the switches S1-S120 is isolated from its neighboring switches S1-S120, thereby reducing cross-talk between the switches S1-S120.

A layer of resiliency compressible insulating foam 110 is disposed between the first 75 and second 90 switch layers so as to bias the switch layers 75, 90 into a switch open configuration wherein the first 75 and second 90 switch layers are separated from each other by the compressible foam 110. The foam separator 110 is provided with through holes 115, such that the foam 110 forms a honeycomb like structure. The squares 80 of conducting material of the first layer 75 are aligned so that they face corresponding rows 95 of conductive material on the second layer 90. In use, the squares 80 of conductive fabric on the first switch layer 75 and the rows 95 of conductive fabric on the second switch layer 90 are relatively movable together in response to an impact, compressing the foam separator 110 in the process until the two conductive fabric contacts 80, 95 of the impacted switch(es) S1-S120 touch through the through holes 115 in the foam 110, thereby closing the switch(es) S1-S120 in the area of the impact. Upon removal of the impact force, the resiliently compressible foam 110 returns to its original configuration, separating the switch layers 75, 90 and opening the switch S1-S120 again.
The properties of the foam separator 110 can be selected to customise the properties of the switches S1-S120. The thickness and ease of compression of the foam govern the force of impact required to trigger a switch S1-S120. The thinner the foam and/or the easier the foam is to compress, the less force is required to trigger the switch S1-S120. The foam is advantageous in that it damps the spread of the impact and improves localisation of the compression to the area of impact.

The squares 80 of conductive fabric of the first layer 75 are joined together in columns by connectors 120, such as wires. The wires 120 run in straight lines along the borders 100 between switches. The connection between the appropriate column connector 120a-l and each square 80 in the appropriate column is made via a diode 125 (as shown in Figure 5(a)), arranged to prevent the flow of current from the conductive square 80 to the appropriate connector 120a-l, but allow the flow of current from the appropriate connector 120a-l to the conductive square 80.

Thus, in effect, the squares 80 of conductive fabric, foam separator 110 and rows 95 of conductive fabric form a grid 65 of switches S1-S120, with a first terminal (formed by a square 80 of conductive fabric) of each switch S1-S120 in each column of the grid 65 being connected to a shared column input 120a-l and each switch S1-S120 in a row sharing a common second output terminal (formed by a row of conductive fabric 95a-j), as shown in Figure 5(a). As an example, the interface 25 may have a 12x10 array of switches S1-S120 formed by twelve columns 120a-l and ten rows 95a-j.

Each of the output rows 95a-j is optionally provided with de-bouncing apparatus, such as Schmitt-trigger NAND gates 135 and/or RC-filters 140. Optionally, de-bouncing may be performed using a computer and/or software based de-bouncing routine. In this way, spurious readings from the switches S1-S120 are minimized. The interface is provided with at least one power filter 145 adapted to remove unintended variations in the input signal, which may lead to artifacts in the impact detection.

The interface 25 is provided with an interface controller 150. The interface controller 150 is connected to each of the shared input connectors 120a-l forming the column inputs and also to each of the rows 95a-j of conductive fabric. The interface
controller 150 is arranged to poll the columns of conductive squares 80 by sequentially applying an electrical signal to one column connector 120a-I at a time. The interface controller 150 is simultaneously arranged to monitor the current on each of the rows 95a-j of conductive fabric. The polling of the column connectors 120a-I is carried out at high speed in order to provide effectively near simultaneous monitoring of each of the columns of switches 80. The interface controller 150 is arranged to provide a delay between the application of a signal to each column 120a-I, so as to minimize cross talk between the columns 120a-I. By determining the rows 95a-j that show a reading when a signal is being applied to a particular column 120a-I, the interface controller 150 can determine which of the switches S1-S120 in that column are closed, i.e. are subject to an impact. For example, if an input signal is applied to the first column shared input connector 120a and outputs are received by the interface controller 150 from the first 95a and third 95c rows, then this is indicative of impacts corresponding to the area covered by the switches S1, S25 formed from the first and third conductive fabric squares 80 in the first column.

The diodes 125 serve to prevent feedback that may result when several switches S1-S120 in a row are closed and one of the switches S1-S120 belongs to a column 120a-I that has a signal applied to it. In this case, the signal runs from the shared column, through the closed switch to the row to which the closed switch belongs. If another switch connected to that row is also closed, then, in the absence of the diodes 125, the signal would then feed back through each closed switch in that row to the shared column connector for each of those switches. This may lead to spurious switch closed readings on rows via closed switches on columns that aren't intended to have a signal applied to them. The diodes 125 serve to block this feedback route, whilst still allowing normal operation of the switch array 65.

For example, if switches S1, S2, S14 and S25 in Figure 5(b) are closed due to an impact on the surface 45 of the interface 25, a signal applied to the first column connector 120a would lead to the signal passing through closed switches S1 and S25 to the first 95a and third 95c shared rows. The signals on the first 95a and third 95c rows are detected by the interface controller 150, which then correctly determines that the first S1 and third S25 switches in the first column are closed. However, in the absence of the diode 125 associated with switch S2, the signals on
the first row 95a would also feed back though closed switch S2 to the second shared column connector 120b. The signal could then pass from the second shared column connector 120b through closed gate S14 to the interface controller 150 via the second row 95b. As the interface controller 150 is applying a signal to the first column connector 120a at this time, the interface controller 150 would incorrectly determine that it was the second switch S13 in the first column that was closed and not the second switch S14 in the second column. The diodes 125 between the shared column connectors 120a-I and the switches S1-S120 block feedback signals from the shared row outputs 95a-j from reaching the column connector inputs 120a-I and thereby eliminates inaccuracies and spurious reading due to feedback. This is particularly important as the system 5 is arranged to receive and determine multiple impact sites. Therefore, elimination of cross-talk and feedback due to multiple impact sites as a result of the above process is especially beneficial in such systems.

Although the threshold force required to close a switch S1-S120 can be determined through appropriate selection of materials and parameters of the soft switches, such as the compressibility and/or thickness of the foam separator 110, an accelerometer 155 is embedded in the interface in order to determine the force of the impacts, as shown in Figure 3. The accelerometer 155 is embedded in the interface 25 such that it is actutable by an impact at any location on the surface 45. The interface controller 150 is arranged to monitor the accelerometer 155 output simultaneously with the monitoring of impact locations using the array 65 of switches S1-S120. In this way, the array of soft switches S1-S120 provides an indication of the location of any impacts and a minimum impact force threshold, whilst the accelerometer 155 provides an indication of the force of any impacts. This allows the system 5 to operate using both location and force related considerations. For example, in a video game, more points can be awarded for higher force impacts. The accelerometer 155 provides a cheap, simple and robust method of measuring impact force. However, a skilled person would realise that alternative force measurement technologies could be used, such as piezo crystals or capacitive sensors/switches. Furthermore, whilst only one accelerometer is described, it will be appreciated that a plurality of accelerometers may be provided.
As shown in Figure 6, the interface controller 150 may be part of the interface 25, a separate unit or part of the system controller 10. The system controller 10 comprises a sensor interface 160 for communicating with the interface controller 150, a video conferencing module 165, a display module 170 and a game module 175. Optionally, the sensor controller comprises a controller board, which may comprise a suitably programmed processor or other suitable means known in the art.

The video conferencing module 165 is arranged to interface with the camera 30 and microphone 50 in order to capture and process video and audio of the user 20. The camera 30 is mounted behind the user 20 and oriented towards the projection surface 45 of the interface 25 so as to capture images of the user 20 in front of a background formed by the projection surface 45. The video of the user 20 is processed to convert it into a binary (black and white) image representing a silhouette or shadow of the user 20. The video conferencing module 165 is arranged to convert the image by applying thresholding to the image based on luminescence. As the outer surface 45 of the interface 25 provided by the stretch fabric 60 is white or retroreflective, the camera 30 generally detects a higher luminescence for those areas of the image corresponding to the background than for those areas of the image corresponding to the user 20. By selecting an appropriate luminescence threshold, the video conferencing module 165 allocates those areas of the collected image having a luminescence below the threshold as representing the user 20 and those areas of the image above the threshold as representing the background. The video conferencing module 165 is operable to encode the image using run length encoding and transmit the encoded binary image and audio of the first user 20a over the network to a second interface system 15b and receive binary video images and audio of the second user 20b from the second interface system 25b. Alternatively, other encoding schemes apparent to a skilled person may be used. By utilising encoding of a binary image, the transmission speed and network utilisation is reduced.

The sensor interface 160 is arranged to communicate with the interface controller 150 in order to receive locations of impacts on the interface surface 45 and translate them into game events.
The game module 175 is arranged to communicate with the sensor interface 160, the video conferencing module 165 and the display module 170. The game module 175 is arranged to receive binary image information of each user 20a, 20b from the video conferencing module 165 and send the image 45 relating to the second user 20b to the display unit 170 for display by the projector system 35 onto the projection surface 45a of the interface 15a being used by the first user 20a. The game module 175 is also in communication with the sensor interface 160 in order to receive the location of impacts made by the first user 20a on the surface 45a of the first interface 15a. The game module 175 is arranged to monitor for impacts and compare the location of the impacts on the interface surface 45a with the locations of the interface surface 45a on which the binary image 40 of the second user 20b is projected. The system 5 is arranged to monitor for multiple simultaneous impacts. Various methods may be used for determining whether or not an impact is made on part of the image 40, as would be known in the art. As an example, a coverage threshold could be set such that if an area of a closed switch S1-S120 is covered by the binary image 40 of a user 20 is above a threshold area, then the game controller 175 is arranged to treat this impact as a hit.

Impact force, as determined by the accelerometer 155, is also provided to the game module 175 via the sensor interface 160. The impact force and number of impacts determined to be hits are used to update each user's score appropriately.

Corresponding arrangements also apply to the operation of the second interface 15b for use by the second user 20b.

The game module 175 then communicates hit information to the display module 170, which displays graphics indicative of a hit on the screen, updates scores and sends appropriate audio to the speakers 55. For example, the display module 170 may overlay a symbol and/or words such as "hit" or "pow" at a location on the interface surface 40a, 40b corresponding with the recorded hit.

In operation, the users 20a, 20b try to strike the respective interface surfaces 40a, 40b on an area corresponding to the projected image of the other user 20a, 20b, as shown in Figures 6 and 7. The strikes may be made by parts of the user such as
hands or feet, or by the user's entire body. The strikes may also be made using implements or objects such as sticks, balls or weapons.

A skilled person will appreciate that variations of the disclosed arrangements are possible without departing from the invention. For example, although the system 5 is described as having two interaction systems 15a, 15b, it will be appreciated that the system 5 may be adapted for use with one or more interaction systems. In addition, whilst the system 5 is described as monitoring and projecting silhouettes of users 20a, 20b of the interaction systems 15a, 15b, in practice, the projected image 40 could be a computer generated image, a computer enhanced image based on the collected user image or a pre-recorded video image. Furthermore, whilst the system 5 is described as using a binary or silhouette image, it will be appreciated that other video image forms may be used, such as grey-scale images or colour images. In addition, whilst the system 5 is described in the context of playing a boxing type game, it will be appreciated that the system may be used with a variety of games that operate according to a variety of different game play formats or arrangements. Indeed, the system 5 is not limited to use in a game situation and may be used in any computer interaction environment or application that requires determination of a touch or impact input, such as exercise machines, simulators, physical training simulators, physical therapy devices, rehabilitation devices or machinery, remote device and/or virtual reality control or as an input device to a computer system. Although the arrays 65 of sensors are described as 12x10 arrays of square switches, it will be appreciated that any arrangement and/or shape and/or size of switch array may be used. Whilst the system 5 described herein includes an array of discrete switches S1-S120, each switch determining impacts within it's own discrete area and with an insulating band around each switch, it will be appreciated that, in an alternative embodiment, overlapping switches may be provided in order to increase the resolution of the system. This may be achieved through the provision of multiple layers of the conductive fabric based switches as described herein. The thin nature of the conductive fabric switches allows provision of multiple layers without resulting in a bulky interface. Indeed, two layers 90 of output rows 95a-j may share a single layer 75 of input terminals 80, each output layer 80 being separated by the input layer 75 by a resistive honeycomb foam layer 110. Furthermore, although the system is responsive to brute force impacts, it will be appreciated that the impacts may be touch, or other gentler impacts, depending on the configuration.
of the interface. Accordingly the above description of the specific embodiment is made by way of example only and not for the purposes of limitation. It will be clear to the skilled person that minor modifications may be made without significant changes to the operation described.
CLAIMS

1. An interface comprising a surface associated with at least two switches, the switches being operable responsive to impacts on at least a portion of the surface, and feedback prevention means arranged such that when at least one of the switches is closed, flow of current through the closed switch to at least one other switch is prevented.

2. An interface according to claim 1, wherein the switches are operable between at least an open configuration and a closed configuration.

3. An interface according to claim 1 or claim 2, wherein the interface comprises means for determining whether at least one of the switches is in an open or closed configuration.

4. An interface according to claim 3, wherein the feedback prevention means is arranged to prevent the configuration of at least one of the switches affecting the ability of the means for determining to determine the configuration of at least one other switch.

5. An interface according to any of the preceding claims, wherein the feedback prevention means is arranged to selectively block current flowing in at least one direction through the at least one switch.

6. An interface according to any of the preceding claims, wherein the at least one switch comprises at least an input terminal and an output terminal.

7. An interface according to claim 6, wherein the feedback prevention means is arranged to prevent flow of current through the at least one switch from the output terminal to the input terminal when the at least one switch is in the closed position.
8. An interface according to any of the preceding claims, wherein the switches are arranged in an array, which optionally comprises a grid.

9. An interface according to any of the preceding claims, wherein the switches are arranged into at least one first subset and/or at least one second subset.

10. An interface according to claim 9, wherein each first subset comprises one or more switches, wherein the input terminal of each switch in the first subset is electrically connected.

11. An interface according to claim 9 or claim 10, wherein each first subset comprises a column of switches.

12. An interface according to any of claims 9 to 11, wherein each second subset comprises one or more switches, wherein the output terminal of each switch in the second subset is electrically connected.

13. An interface according to any of claims 9 to 12, wherein each second subset comprises a row of switches.

14. An interface according to any of claims 9 to 13, wherein each switch is associated with a first and a second subset.

15. An interface according to any of claims 6 to 14, wherein the interface comprises a controller adapted to apply electrical signals to the switch input terminals.

16. An interface according to claim 15, wherein the controller is adapted to selectively apply electrical signals to input terminals of switches in selected subsets or columns.

17. An interface according to claim 16, wherein the controller is adapted to sequentially apply electrical signals to respective first subsets.
18. An interface according to any of claims 15 to 17, when dependant upon claim 2, wherein the controller comprises the means for determining whether at least one of the switches is in an open or closed configuration.

19. An interface according to any of claims 15 to 18, wherein the controller is adapted to monitor the output terminals for electrical signals.

20. An interface according to any of claims 15 to 19, wherein the controller is adapted to simultaneously monitor the electrically connected output of each row of switches.

21. An interface according to any of the preceding claims, wherein the feedback prevention means is arranged to prevent flow of current from the electrically connected output terminals of at least one row or second subset of switches to the electrically connected input terminals of at least one column or first subset of switches.

22. An interface according to any of the preceding claims, wherein all of the switches have an associated feedback prevention means.

23. An interface according to any of the preceding claims, wherein the feedback prevention means comprise a diode.

24. An interface according to claim 23, wherein the diode is located between the input or output terminal of the switch and the respective electrical connector.

25. An interface according to claims 23 or claim 24, wherein the diode is arranged to allow flow of current from the electrical connection associated with the input terminal to the electrical connection associated with the output terminal and/or block flow of current through the switch from the electrical connection associated with the output terminal to the electrical connection associated with the input terminal.
26. An interface according to any of claims 1 to 25, wherein at least part of the interface is adapted to be resiliently compressible and/or deformable in response to an impact.

27. An interface according to claim 26, wherein the switches are formed from a resiliently compressible insulator disposed between two switch layers, each switch layer at least partially comprising conductive material, such that, when the switch is in an open configuration, the two switch layers are separated by the compressible insulator.

28. An interface according to claim 27, wherein the compressible insulator comprises through apertures, such that the two layers comprising conductive material may contact each other when the switch and thereby the insulator is compressed.

29. An interface according to claim 27 or claim 28, wherein the compressible insulator may be formed from foam.

30. An interface according to any of claims 27 to 29, wherein a first switch layer comprises at least one discrete panel of conductive material, each panel defining the area of one switch.

31. An interface according to any of claims 27 to 30, wherein a second switch layer comprises at least one discrete panel of conductive material, each panel of conductive material of the second layer being arranged to cooperate with one or more panels of conductive material of the first layer in order to form at least one switch.

32. An interface according to claim 31, wherein the panels of the second layer may be rows or columns of conductive material.

33. An interface according to any of claims 27 to 32, wherein the first and/or second layer comprise discrete panels of conductive material affixed to an insulating backing sheet.
34. An interface according to any of claims 27 to 33, wherein the conductive material is a conductive fabric.

35. An interface according to claim 34, wherein the conductive fabric is a rip-stop conductive fabric.

36. An interface according to any of the preceding claims, wherein the interface comprises an outer stretch fabric layer, which may optionally cover the switches to thereby provide the surface for receiving impacts.

37. An interface according to any of the preceding claims, wherein the surface, which may optionally comprise an outer surface of the stretch fabric layer, is white and/or retroreflective.

38. An interface according to any of the preceding claims, wherein the interface comprises a resiliently deformable backing layer, which may optionally be a foam backing layer.

39. An interface according to any of claims 27 to 38, wherein the rigidity of the backing layer and/or the insulator is selected to allow the interface to stand upright, with the surface for receiving impacts arranged generally perpendicularly to the floor without a supporting structure.

40. An interface according to any of the preceding claims, wherein the interface comprises at least one accelerometer.

41. An interface according to claim 40, wherein the accelerometer is embedded in the insulator layer.

42. An interface according to claims 40 or 41, wherein the accelerometer is arranged to be actutable by impacts to the surface of the interface, and optionally the accelerometer is actutable by impacts to substantially any point of the interface surface.
43. An interface according to any of claims 40 to 42, wherein the accelerometer is adapted to determine the force of impacts on the interface.

44. An interface according to any of the preceding claims, wherein the switches are adapted to be responsive to physical impacts and/or impacts applied with physical and/or brute force.

45. An interface comprising a surface associated with at least two switches, the switches being operable between at least an open configuration and a closed configuration responsive to impacts on at least a portion of the surface; the interface further comprising means for determining the configuration of at least one switch and feedback prevention means arranged to prevent the configuration of at least one of the switches affecting the ability of the means for determining to determine the configuration of at least one other switch.

46. A system comprising a controller and at least one interface according to any of claims 1 to 45.

47. A system according to claim 46, wherein the system is a gaming system.

48. A system according to claim 47, wherein the system is a computer based system.

49. A system according to any of claims 46 to 48, wherein the system further comprises at least one projector adapted to project an image onto the outer surface of at least one interface.

50. A system according to claim 49, wherein the image is an image of a user and/or may represent a silhouette of a user.

51. A system according to any of claims 46 to 50, wherein the system comprises at least one image capture device.
52. A system according to claim 51, wherein the image capture device is arranged to collect a video image of a user.

53. A system according to claim 52, wherein the video image is an image mask or silhouette image and/or the controller may be adapted to convert the image into an image mask or silhouette image.

54. A system according to any of claims 46 to 53, wherein the system comprises communications apparatus for communicating with at least one other system and/or interface.

55. A system according to claim 54, wherein the at least one other system and/or interface is a remote system and/or interface.

56. A system according to claim 54 or claim 55, wherein the communications apparatus is operable in conjunction with a network.

57. A system according to any of claims 46 to 56, wherein the controller is adapted to communicate with the interface and thereby determine the location of impacts on the outer surface of the interface.

58. A system according to any of claims 54 to 58, wherein the system is adapted to receive a video image of an entity or user from at least one remote system.

59. A system according to claim 58, wherein the system is adapted to project the video image of the entity or user onto the outer surface of the interface.

60. A system according to claim 59, wherein the system is adapted to determine areas of the outer surface onto which the image of the entity or user is projected.

61. A system according to claim 60, wherein the system is adapted to determine if the location of at least one impact on the outer surface
corresponds to an area of the outer surface onto which the video image of the entity or user is projected.

62. A controller for use with or in the interface according to any of claims 15 to 20 or with or in the system according to any of claims 46 to 61.

63. A computer program product, or carrier means containing a computer program product, arranged to implement an interface according to any of claims 1 to 45 or the system of any of claims 46 to 61 or the controller of claim 62.

64. An apparatus comprising, or programmed with, the computer program product of claim 63.
Figure 5(b)

Figure 6