

TOUCH CONTROL MODULE

Technical Field

[0001] Various embodiments generally relate to a touch control module. In particular, various embodiments generally relate to a touch control module for (e.g. for controlling) an electronic device.

Background

[0002] In recent years, more and more electronic devices are provided with a touch control module for receiving inputs from a user. The user may tap, slide, swipe, etc., on the touch control module for controlling various functions of the electronic devices. For example, the user may tap for activating or deactivating certain functions of the electronic device, or the user may slide or swipe to change intensity, such as for lighting or volume or brightness etc. Further, the touch control module may come with visual indicators or markers for displaying to the user where to tap or slide or swipe. These visual indicators may be static visual indicators (that are permanent and fixed) or dynamic visual indicators (that varies or changes depending on what inputs the electronic device requires). The visual indicators may be based on Light Emitting Diodes (LEDs) or a display screen or permanent markings.

[0003] An example of an electronic device with a touch control module is a light bar. The light bar is an accessory that can be attached to the front of a computer monitor to provide additional lighting in a workspace. Due to the rising trend of working from home and participating in video conferences, light bars for computer monitors have become increasingly popular.

[0004] The touch module of the light bar can be used to adjust brightness, color temperature, or turn the light bar on or off. The touch module is typically located on the side of the light bar and consists of several touch-sensitive buttons that can be used to control the light bar's settings. LEDs on the touch module may serve as indicators to show a current setting, such as a selected brightness level or color temperature.

[0005] However, due to space constraints of electronic devices such as the light bar, the touch modules for such devices may have inaccurate touch sensitivity as well as inadequate touch points and/or visual indicators.

[0006] Accordingly, there is a need to provide an improved touch module, for electronic devices, such as a light bar, which addresses at least the above issues.

Summary

[0007] According to various embodiments, there may be provided a touch control module. The touch control module may include a touch plate that includes at least one primary light transmissible region and at least one auxiliary light transmissible region, side-by-side along an inline axis along the touch plate. The touch control module may include (e.g. further include) a circuit assembly. The circuit assembly may include a touch sensing arrangement disposed relative to the light transmissible touch plate for sensing a touch on the light transmissible touch plate, and a lighting arrangement for selectively illuminating between the at least one primary light transmissible region and the at least one auxiliary light transmissible region of the touch plate. The lighting arrangement may include at least one main light source disposed along a first alignment axis parallel to the inline axis of the touch plate for illuminating the at least one primary light transmissible region of the touch plate, and at least one auxiliary light source disposed along a second alignment axis parallel to the inline axis of the touch plate and offset from the first alignment axis for illuminating the at least one auxiliary light transmissible region of the touch plate. The touch control module may include (e.g. further include) a light-channelling arrangement disposed between the lighting arrangement of the circuit assembly and the touch plate, the light-channelling arrangement providing at least one primary light path extending from the at least one main light source to the at least one primary light transmissible region and at least one auxiliary light path extending from the at least one auxiliary light source to the at least one auxiliary light transmissible region. The light channelling assembly may further shield the at least one primary light transmissible region from the at least one auxiliary light source and shield the at least one auxiliary light transmissible region from the at least one main light source.

Brief description of the drawings

[0008] In the drawings, like reference characters generally refer to the same parts throughout the different views. The drawings are not necessarily to scale, emphasis instead generally being placed upon illustrating the principles of the invention. In the following

description, various embodiments are described with reference to the following drawings, in which:

FIG. 1 is a schematic block diagram of a touch control module, according to various embodiments;

FIG. 2A shows an exploded perspective view of a first variant touch control module, according to various embodiments;

FIG. 2B is a close-up perspective view of a primary light passage of an assembled touch control module of FIG. 2A, according to various embodiments;

FIG. 2C and FIG. 2D are close-up perspective views of an auxiliary light passage of an assembled touch control module of FIG. 2A, according to various embodiments;

FIG. 2E and FIG. 2F are schematic diagrams showing an example touch sensing arrangement on a main circuit board, for a circuit assembly of the touch control module of FIG. 2A, according to various embodiments;

FIG. 2G shows a rear perspective view of an assembled touch control module of FIG. 2A, according to various embodiments;

FIG. 2H shows an exploded view of FIG. 2G, according to various embodiments;

FIG. 2I shows the touch control module of FIG. 2A fitted into a light bar, according to various embodiments;

FIG. 3A shows an exploded perspective view of a second variant touch control module, according to various embodiments;

FIG. 3B is a close-up perspective view of a primary light passage of an assembled touch control module of FIG. 3A, according to various embodiments;

FIG. 3C is a close-up perspective view of an auxiliary light passage of an assembled touch control module of FIG. 3A, according to various embodiments;

FIG. 3D is a close-up view of a rectangular-shaped touch sensing element of the touch sensing arrangement on the main circuit board of the touch control module of FIG. 3A, according to various embodiments;

FIG. 3E is a close-up view of a circular-shaped touch sensing element of the touch sensing arrangement on the main circuit board of the touch control module of FIG. 3A, according to various embodiments;

FIG. 3F and FIG. 3G are schematic diagrams showing an example touch sensing arrangement on a main circuit board, for a circuit assembly of the touch control module of FIG. 3A, according to various embodiments;

FIG. 3H shows a rear perspective view of an assembled touch control module of FIG. 3A, according to various embodiments;

FIG. 3I shows an exploded view of FIG. 3H, according to various embodiments;

FIG. 3J shows the touch control module of FIG. 3A fitted into a light bar, according to various embodiments;

FIG. 4A shows a frontal perspective view of a light bar with a touch control module, according to various embodiments;

FIG. 4B shows a close-up view of a touch plate of the touch control module of the light bar of FIG. 4A, according to various embodiments;

FIG. 4C shows a rear perspective view of the light bar of FIG. 4A, according to various embodiments; and

FIG. 4D shows a close-up view of an end cap of a housing of the light bar of FIG. 4A, according to various embodiments.

Detailed description

[0009] Embodiments described below in the context of the apparatus are analogously valid for the respective methods, and vice versa, as well as for a corresponding kit. Furthermore, it will be understood that the embodiments described below may be combined, for example, a part of one embodiment may be combined with a part of another embodiment.

[00010] It should be understood that the terms “on”, “over”, “top”, “bottom”, “down”, “side”, “back”, “left”, “right”, “front”, “lateral”, “side”, “up”, “down” etc., when used in the following description are used for convenience and to aid understanding of relative positions or directions, and not intended to limit the orientation of any device, or structure or any part of any device or structure. In addition, the singular terms “a”, “an”, and “the” include plural references unless context clearly indicates otherwise. Similarly, the word “or” is intended to include “and” unless the context clearly indicates otherwise.

[00011] Various embodiments generally relate to a touch control module (or touch module) for controlling an electronic device, such as a light bar for a computer monitor, or any other suitable electronic device, such as a touch screen, touch control panel, etc.

[00012] Various embodiments seek to provide a touch control module with improved touch sensing accuracy and closer touch points with closer visual indicators (or markers) packed within a confined space. Further, the touch control module may also switch appearance or visual indicators within the confined space.

[00013] The touch control module according to the various embodiments may include a first set of at least one (in other words, one or more) light source (i.e. main light source) for displaying a first set of visual indication(s) or appearance(s) (i.e. at least one primary light transmissible region) and a second set of at least one light source (i.e. auxiliary light source) for displaying a second set of visual indication(s) or appearance(s) (i.e. at least one auxiliary light transmissible region). The first set of at least one light source may be aligned along a first reference axis of the touch control module, and the second set of at least one light source may be aligned along a second reference axis of the touch control module. Particularly, the second reference axis may be offset from the first reference axis. In various other embodiments in which the touch control module includes a plurality of main light sources and a plurality of auxiliary light sources, the plurality of main light sources and the plurality of auxiliary light sources may form two separate and distinct (e.g. spaced apart) rows of light sources. In this manner, the touch control module according to the various embodiments may accommodate a larger number of light sources than conventional touch modules. To illustrate, by having two discrete rows of light sources, the main light sources and the auxiliary light sources may be in a staggered and/or alternating arrangement with each other (e.g. along a longitudinal direction of the touch control module), thereby allowing for a larger number of light sources to be packed (e.g. along the longitudinal direction of the touch control module).

[00014] The touch control module according to the various embodiments may further include a light-channelling arrangement. The light-channelling arrangement may be configured to isolate light emitted from each light source of the touch control module so as to prevent or minimize light leakage from the light sources of the touch control module. Specifically, the light-channelling arrangement may channel or direct light emitted from each light source of the touch control module to be along a dedicated (e.g. single) or predetermined light path. Accordingly, the light-channelling arrangement may prevent the light emitted from each light source of the touch control module from illuminating other part(s) or region(s) of the touch control module due to stray lighting, and may only illuminate a designated part or region (e.g. at least one primary light transmissible region or at least one auxiliary light transmissible region) of the touch control module associated with said light source.

[00015] In addition to the above, the touch control module according to the various embodiments may include or be configured with a touch sensing setup (i.e. a touch sensing

arrangement), which may involve configuration and/or placement of touch sensors (i.e. touch sensing elements) and/or routing of sensing signals. The touch sensing setup may help reduce or prevent cross-talk and/or an occurrence of false sensing signals being triggered.

[00016] Furthermore, according to the various embodiments, the components of the touch control module may be stacked in a predetermined or specific order (or sequence) to achieve a compact form factor of the touch control module. Accordingly, the touch control module may fit within most electronic devices or be installed (or retrofitted) in the housings of an existing electronic devices that may have limited or a confined internal space.

[00017] The following Examples pertain to various embodiments.

[00018] Example 1 is a touch control module. The touch control module may include a touch plate that includes at least one primary light transmissible region and at least one auxiliary light transmissible region side-by-side along an inline axis along the touch plate. The touch control module may include (e.g. further include) a circuit assembly. The circuit assembly may include a touch sensing arrangement disposed relative to the light transmissible touch plate for sensing a touch on the light transmissible touch plate, and a lighting arrangement for selectively illuminating between the at least one primary light transmissible region and the at least one auxiliary light transmissible region of the touch plate. The lighting arrangement may include at least one main light source disposed along a first alignment axis parallel to the inline axis of the touch plate for illuminating the at least one primary light transmissible region of the touch plate, and at least one auxiliary light source disposed along a second alignment axis parallel to the inline axis of the touch plate and offset from the first alignment axis for illuminating the at least one auxiliary light transmissible region of the touch plate. The touch control module may include (e.g. further include) a light-channelling arrangement disposed between the lighting arrangement of the circuit assembly and the touch plate, the light-channelling arrangement providing at least one primary light path extending from the at least one main light source to the at least one primary light transmissible region and at least one auxiliary light path extending from the at least one auxiliary light source to the at least one auxiliary light transmissible region. The light channelling assembly may further shield the at least one primary light transmissible region from the at least one auxiliary light source and shield the at least one auxiliary light transmissible region from the at least one main light source.

[00019] In Example 2, the subject matter of Example 1 may optionally include that wherein the light-channelling arrangement includes at least one auxiliary light passage

defining the at least one auxiliary light path, the at least one auxiliary light passage including at least one auxiliary light-channelling-surface surrounding the at least one auxiliary light path so that the at least one auxiliary light-channelling-surface channels light, emitted from the at least one auxiliary light source along the at least one auxiliary light path.

[00020] In Example 3, the subject matter of Example 2 may optionally include that wherein the light-channelling arrangement includes (e.g. further includes) a light-isolating structure disposed between the touch plate and the lighting arrangement of the circuit assembly, the light-isolating structure including at least one auxiliary through-hole extending across the light-isolating structure. At least one inner surface of the at least one auxiliary through-hole of the light-isolating structure may serve as at least a segment of the at least one auxiliary light-channelling-surface of the at least one auxiliary light passage.

[00021] In Example 4, the subject matter of Example 3 may optionally include that wherein the light-channelling arrangement includes (e.g. further includes) at least one light guide fitted to the at least one auxiliary light passage and optically coupled to the at least one auxiliary light source to direct light, emitted from the at least one auxiliary light source, through the at least one auxiliary light passage along the at least one auxiliary light path.

[00022] In Example 5, the subject matter of Example 4 may optionally include that wherein the circuit assembly includes a main circuit board. The main circuit board may include at least one auxiliary through-hole extending across the main circuit board, the at least one auxiliary through-hole of the main circuit board aligned with the at least one auxiliary through-hole of the light-isolating structure. At least one inner surface of the main circuit board of the at least one auxiliary through-hole of the main circuit board may serve as at least another segment of the at least one auxiliary light-channelling-surface of the at least one auxiliary light passage.

[00023] In Example 6, the subject matter of Example 5 may optionally include that wherein the circuit assembly further includes an auxiliary circuit board. The main circuit board may be disposed between the auxiliary circuit board and the touch plate. The at least one main light source and the at least one auxiliary light source may be disposed on a component-face of the auxiliary circuit board that is directed towards the touch plate.

[00024] In Example 7, the subject matter of any one of Examples 3 to 6 may optionally include that wherein the light-isolating structure includes a plate portion and at least one tubular portion extending from the plate portion. A first end region of the at least one tubular portion being at the plate portion. The at least one auxiliary through-hole of the light-

isolating structure may extend along the plate portion along a thickness direction thereof and through the at least one tubular portion along a longitudinal axis thereof. A second free end region of the at least one tubular portion, opposite the first end region of the at least one tubular portion, may surround the at least one auxiliary light source (in other words, the at least one auxiliary light source may be within the at least one tubular portion).

[00025] In Example 8, the subject matter of Example 7 may optionally include that wherein the circuit assembly may include a main circuit board and an auxiliary circuit board, the main circuit board disposed between the auxiliary circuit board and the touch plate. The at least one main light source may be disposed on a component-face of the main circuit board that is directed towards the touch plate. The at least one auxiliary light source may be disposed on a component-face of the auxiliary circuit board that is directed towards the touch plate. The main circuit board may include at least one opening extending across the main circuit board and aligned with the at least one auxiliary light source. The second free end region of the at least one tubular portion may extend into the at least one opening of the main circuit board to surround the at least one auxiliary light source.

[00026] In Example 9, the subject matter of any one of Examples 1 to 9 may optionally include that the second alignment axis is offset from the first alignment axis in a direction perpendicular to the first alignment axis.

[00027] In Example 10, the subject matter of Example 9 may optionally include that the circuit assembly includes a circuit board. The at least one main light source and the at least one auxiliary light source may be disposed on a component-face of the circuit board that is directed towards the touch plate.

[00028] In Example 11, the subject matter of Example 10 may optionally include wherein the at least one main light source is oriented in a manner such that a light emission direction of the at least one main light source is along a first direction towards the touch plate. The at least one auxiliary light source may be oriented in a manner such that a light emission direction of the at least one auxiliary light source is along a second direction different from the first direction.

[00029] In Example 12, the subject matter of Example 11 may optionally include that wherein the second direction is perpendicular to the first direction.

[00030] In Example 13, the subject matter of Example 11 may optionally include that the circuit assembly includes a main circuit board and an auxiliary circuit board, the main circuit board disposed between the auxiliary circuit board and the touch plate. The at least one main

light source may be disposed on a component-face of the main circuit board that is directed towards the touch plate. The at least one auxiliary light source may be disposed on a component-face of the auxiliary circuit board that is directed towards the touch plate.

[00031] In Example 14, the subject matter of Example 13 may optionally include that wherein the at least one main light source and the at least one auxiliary light source are oriented in a manner such that a light emission direction of the at least one main light source and a light emission direction of the at least one auxiliary light source are along a same direction towards the touch plate.

[00032] In Example 15, the subject matter of any one of Examples 1 to 14 may optionally include a light diffuser disposed between the lighting arrangement and the touch plate. The light diffuser may be configured to diffuse light, emitted from the lighting arrangement through the light diffuser, for evenly distributing the light to the touch plate for illuminating a corresponding light transmissible region of the touch plate.

[00033] In Example 16, the subject matter of any one of Examples 1 to 15 may optionally include that the touch sensing arrangement includes a plurality of touch sensing elements, each touch sensing element disposed about a normal axis of a corresponding region of the at least one primary light transmissible region or the at least one auxiliary light transmissible region of the touch plate. At least a pair of neighbouring touch sensing elements of the plurality of touch sensing elements may be configured with different sensitivity setting from one another.

[00034] In Example 17, the subject matter of Example 16 may optionally include that wherein the plurality of touch sensing elements includes a plurality of capacitive sensors or a plurality of induction sensors.

[00035] In Example 18, the subject matter of Example 16 or Example 17 may optionally include that the circuit assembly includes a circuit board with a component-face that is directed towards the touch plate. The plurality of touch sensing elements may be disposed on the component-face of the circuit board. The circuit assembly may further include a processor for controlling the plurality of touch sensing elements, the processor disposed on a connection-face of the circuit board opposite the component-face of the circuit board. The circuit assembly may further include an interconnect structure on the circuit board for enabling the plurality of touch sensing elements and the processor to communicate with each other.

[00036] FIG. 1 is a schematic block diagram of a touch control module 100, according to various embodiments.

[00037] According to various embodiments, there may be provided the touch control module 100. The touch control module 100 may be a “module” (e.g. an integrated module) configured to sense or detect an operator’s (e.g. user’s) touch on a touch plate 101 of the touch control module 100. The operator’s touch on a designated region (e.g. one of a plurality of designated input receiving portion(s)) of the touch plate 101 of the touch control module 100 may represent a desired or intended input by the operator. The touch plate 101 of the touch control module 100 may display visual indications or appearance to show the designated regions that are to be touched by the operator for receiving the desired or intended inputs. Such visual indications or appearances on the touch plate 101 may be light illuminated onto the touch plate 101 from a lighting arrangement 130 of the touch control module 100 (described in detail later). As an illustration, when the touch control module 100 is configured as or fitted within an electronic device such as a light bar to control the light bar, the desired input by the operator may be any one of toggling between turning on and off the light bar, adjusting a light mode of the light bar, adjusting a brightness of light emitted from the light bar, adjusting a color (e.g. color temperature) of light emitted from the light bar, etc.

[00038] Hence, as shown in FIG. 1, according to various embodiments, the touch control module 100 may include the touch plate 101. According to various embodiments, the touch plate 101 may include at least one primary light transmissible region 102 and at least one auxiliary light transmissible region 103. Each of the at least one light transmissible region 102, 103 of the touch plate 101 may be a region (e.g. a portion or a segment or a zone) of the touch plate 101 which allows light to pass (or permeate) therethrough (or thereacross) from one side (e.g. rear side) of two broad sides of the touch plate 101 to another (e.g. opposite) side (e.g. front side) of the two broad sides of the touch plate 101, or vice versa (in other words, across a thickness of the touch plate 101). For instance, each of the at least one light transmissible region 102, 103 of the touch plate 101 may be or may include a light transmissible (e.g. transparent or translucent or semi-transparent) material (e.g. glass, tinted glass, etc.), a through-hole across the touch plate 101, etc. According to various embodiments, the touch plate 101 may be a light transmissible pane. For example, the light transmissible pane may be a single (e.g. continuous) panel or piece of light transmissible material (e.g. glass, clear polymer, etc.). In this configuration, the at least one primary light

transmissible region 102 and the at least one auxiliary light transmissible region 103 may be on (or along or within) the single (e.g. continuous) panel or piece of light transmissible material. Thus, according to various embodiments, the at least one primary light transmissible region 102 and the at least one auxiliary light transmissible region 103 may not be demarcated or separated or partitioned from each other, for instance, by one or more non-light transmissible region(s) or a non-light transmissible material of the touch plate 101. Instead, in such a configuration of the touch plate 101 being the light transmissible pane, each of the at least one primary light transmissible region 102 and each of the at least one auxiliary light transmissible region 103 may be an individual or a discrete region or area of illumination on the touch plate 101 based on light emitted from the at least one main light source 131 or the at least one auxiliary light source 132.

[00039] According to various embodiments, the at least one primary light transmissible region 102 and the at least one auxiliary light transmissible region 103 of the touch plate 101 may be disposed (or arranged) side-by-side (or adjacent to each other) in a lateral manner or lined abreast each other at the touch plate 101. According to various embodiments, the at least one primary light transmissible region 102 and the at least one auxiliary light transmissible region 103 of the touch plate 101 may be disposed side-by-side along an inline axis 11 (e.g. a single reference axis) along or across the touch plate 101. The inline axis 11 may define a direction along which the visual indicators or markers are laid out one after another. As a non-limiting example, the inline axis 11 may be extending longitudinally across the touch plate 101 (e.g. an elongate touch plate 101) and/or may be parallel with a longitudinal axis of the touch plate 101 (e.g. elongate touch plate 101).

[00040] According to various embodiments, any one region or more than one region or all of the primary light transmissible region(s) 102 and/or the auxiliary light transmissible region 103(s) of the touch plate 101 may correspond to a respective input receiving portion of the touch plate 101. Each input receiving portion of the touch plate 101 may correspond to (or serve or function as) a “touch button” (e.g. a touch-sensitive button) of the touch control module 100. Thus, when the touch control module 100 detects or senses (e.g. by way of a touch sensing arrangement 120 of the touch control module 100, described in detail later) an operator’s touch (or detects an input device, e.g. a stylus pen) on (or within a predetermined or pre-configured distance from) the touch plate 101 (e.g. front surface of the touch plate 101), at a corresponding input receiving portion of the touch plate 101, a touch button corresponding to that particular input receiving portion may be activated (or

triggered). Each touch button (e.g. when activated) may correspond to a function or may cause a function to be executed (e.g. by the touch control module 100 or by an electronic device fitted with the touch control module 100). Examples of such function(s) may include toggling between turning on and off the touch control module 100 (or an electronic device, such as a light bar that is fitted with the touch control module 100), adjusting a light mode of the touch control module 100 (or the electronic device), adjusting a brightness of light emitted from the touch control module 100 (or the electronic device), adjusting a color (e.g. color temperature) of light emitted from the touch control module 100 (or the electronic device), etc. Accordingly, the touch control module 100 may include a plurality of touch buttons corresponding to a plurality of functions (e.g. different types of functions).

[00041] According to various embodiments, the touch control module 100 may include (e.g. further include) a circuit assembly 110.

[00042] According to various embodiments, the circuit assembly 110 may include a touch sensing arrangement 120. The touch sensing arrangement 120 may be configured to or may be for sensing or detecting an operator's touch on the light transmissible touch plate 101. More particularly, the touch sensing arrangement 120 may be disposed relative to the light transmissible touch plate 101 in a manner so as to be capable of, or for, sensing or detecting the operator's touch on (or within proximity from) a front side or surface of the light transmissible touch plate 101.

[00043] As shown in FIG. 1, the touch sensing arrangement 120 may include a plurality of touch sensing elements 121, according to various embodiments. Each touch sensing element may be configured to detect or sense the operator's touch at a predetermined (e.g. a unique) input receiving portion (or a sub-set of input receiving portions), that is associated (e.g. aligned) with that touch sensing element, from among a plurality (or sets) of input receiving portions of the touch plate 101. Each touch sensing element may be disposed about or around or may be surrounding and/or may be aligned with a normal axis 14 of one or more primary light transmissible region 102(s) and/or one or more auxiliary light transmissible region 103(s) of the touch plate 101. In this manner, each touch sensing element may detect or sense the operator's touch on, or within proximity to, one or more input receiving portion(s) of the touch plate 101 (i.e. corresponding to one or more touch button(s)).

[00044] According to various embodiments, the plurality of touch sensing elements 121 may be disposed on a same plane (e.g. on a component-face, i.e. front surface, of a

substantially planar circuit board). According to various embodiments, a pair of neighbouring touch sensing elements 121 (or two adjacent touch sensing elements 121) of the touch sensing arrangement 120, may be, but is not limited to being, spaced apart from each other. According to various embodiments, the pair of neighbouring touch sensing elements 121 may be configured with different sensitivity setting (or settings) from one another. In this manner, signals (e.g. sensing signals) generated by each of the aforesaid pair of neighbouring touch sensing elements 121 may be different from each other, and may thus be distinguished from each other, thereby minimizing or eliminating cross-talk between the pair of neighbouring touch sensing elements 121 and/or preventing false trigger(s) by any one or both of the pair of neighbouring touch sensing elements 121. Thus, the touch sensing arrangement 120 of the touch control module 100, according to the various embodiments, may achieve greater sensing accuracy over conventional control modules. As some non-limiting examples, the plurality of touch sensing elements 121 may include a plurality of capacitive sensors, or a plurality of induction sensors (or inductive sensors / coils, etc.), or a combination of different types of sensors (e.g. combination of capacitive and induction sensors).

[00045] To illustrate, according to various embodiments, each touch sensing element 121 may have a different (e.g. unique) sensitivity setting compared to another (e.g. at least one other) touch sensing element 121 within the touch control module 100. This difference in sensitivity may be created, for example, by varying touch sensing pad sizes (or dimensions) and/or the routing of the touch trace to a controller (e.g. a touch sensing controller) of the touch control module 100. At least one criterion may be established for each touch sensing element 121. As an example, according to the criterion, a total count number (e.g. touch count value) of the touch sensing element 121 when the touch sensing element 121 is activated may be less than 95% (e.g. 94%) of the total count number when it is not activated. For instance, if a total count number is “800” in a non-activated state of the touch sensing element 121, the touch count value may be “752” or lower when the touch sensing element 121 is activated.

[00046] Additionally, according to various embodiments, when the controller of the touch control module 100 identifies a “touch button” being touched, an associated firmware of the touch control module 100 may activate a temporary lock on one or more neighbouring touch sensing element(s) 121 to prevent false trigger(s). Similarly, when the controller detects a sliding touch motion (from a user) across input receiving portion(s) of the touch plate 101,

the associated firmware of the touch control module 100 may temporarily lock one or more neighbouring touch sensing element(s) 121.

[00047] According to various embodiments, the circuit assembly 110 may include at least one circuit board 111. The circuit board 111 may include a component-face (e.g. front surface, or a substantially planar or flat front surface) and an opposite connection-face (e.g. rear surface, or a substantially planar or flat rear surface). The circuit board 111 may be oriented in a manner such that its component-face may be directed towards (in other words, directly facing) the touch plate 101. More particularly, according to various embodiments, the circuit board 111 may be disposed and/or arranged and/or positioned and/or oriented relative to the touch plate 101 in a manner such that the rear side or surface of the touch plate 101 and the component-face of the circuit board 111 may be facing (e.g. directly facing) each other (in other words, the rear side or surface of the touch plate 101 and the component-face of the circuit board 111 may be arranged in an opposing manner).

[00048] According to various embodiments, when the touch sensing arrangement 120 includes the plurality of touch sensing elements 121, the plurality of touch sensing elements 121 may be disposed on the component-face of the circuit board 111. The touch control module 100 (e.g. the circuit assembly 110 of the touch control module 100) may include (e.g. further include) a processor. The processor may be coupled or connected to the plurality of touch sensing elements 121 and may be configured to receive signals (e.g. sensing signals from the plurality of touch sensing elements 121). According to various other embodiments, the processor may be coupled (e.g. further coupled) to at least one main light source 131 and/or the at least one auxiliary light source 132 of a lighting arrangement 130 of the touch control module 100 (described below) and may be configured to control the at least one main light source 131 and/or the at least one auxiliary light source 132. For instance, the processor may be configured to adjust a brightness, or a color temperature, etc., of any one or more of the at least one main light source 131 and/or the at least one auxiliary light source 132.

[00049] According to various embodiments, the circuit assembly 110 may include (e.g. further include) the lighting arrangement 130. The lighting arrangement 130 may be configured to or may be for selectively illuminating between the at least one (e.g. one or more / a plurality) primary light transmissible region 102 and/or the at least one (e.g. one or more / a plurality) auxiliary light transmissible region 103 of the touch plate 101. Specifically, the lighting arrangement 130 may include the at least one main light source

131 for illuminating the at least one primary light transmissible region 102 of the touch plate 101. The lighting arrangement 130 may include (e.g. further include) the at least one auxiliary light source 132 (i.e. different light source(s) from the at least one main light source 131) for illuminating the at least one auxiliary light transmissible region 103 of the touch plate 101. As some non-limiting examples, each of the at least one main light source 131 and the at least one auxiliary light source 132 may include or may be a Light Emitting Diode (LED), an Organic Light Emitting Diode (OLED), laser diode, etc.

[00050] The at least one main light source 131 (or one or more main light sources 131) may be disposed along a first alignment axis 12 (e.g. of the touch control module 100) which may be parallel to the inline axis 11 of the touch plate 101. The at least one auxiliary light source 132 may be disposed on a second alignment axis 13 (i.e. a different axis from the first alignment axis 12) (e.g. of the touch control module 100) which may be parallel to the inline axis 11 of the touch plate 101 and offset from the first alignment axis 12. In other words, the first alignment axis 12 may be parallel with the second alignment axis 13 (or all of the first alignment axis 12 and the second alignment axis 13 and the inline axis 11 may be parallel with each other). Further, the second alignment axis 13 may be apart (e.g. non-coincident, and/or non-intersecting, etc.) with respect to the first alignment axis 12.

[00051] The inline axis 11 may be a separate or different or discrete axis from the first alignment axis 12 and the second alignment axis 13. The first alignment axis 12 and the second alignment axis 13 may be laterally offset from the inline axis 11. Thus, the inline axis 11, the second alignment axis 13, and the first alignment axis 12 may be offset from one another.

[00052] According to various embodiments, the second alignment axis 13 may be offset from the first alignment axis 12 in (or along) a direction perpendicular to the first alignment axis 12. In this arrangement, the touch control module 100 may accommodate a higher or larger number of light sources (e.g. along a sideways or longitudinal direction of the touch control module 100, for instance, when the alignment axes are parallel with the longitudinal direction).

[00053] The touch control module 100 may include a light-channelling arrangement 140 configured to channel or direct light emitted from the (e.g. large number of) light sources 131, 132 of the lighting arrangement 130 to effectively illuminate the at least one primary light transmissible region 102 and/or the at least one auxiliary light transmissible region 103 (e.g. several regions positioned adjacent or side-by-side to each other along a single linear

axis, e.g. the inline axis 11) of the touch plate 101. The light-channelling arrangement 140 may be disposed between the lighting arrangement 130 (e.g. the at least one main light source 131 and the at least one auxiliary light source 132) and the touch plate 101. The light-channelling arrangement 140 may provide or include at least one primary light path 141 extending from the at least one main light source 131 to the at least one primary light transmissible region 102 and may provide or include at least one auxiliary light path 145 extending from the at least one auxiliary light source 132 to the at least one auxiliary light transmissible region 103. According to various embodiments, the light-channelling arrangement 140 may be configured to shield the at least one primary light transmissible region 102 from the at least one auxiliary light source 132 and to shield the at least one auxiliary light transmissible region 103 from the at least one main light source 131.

[00054] According to various embodiments, the light-channelling arrangement 140 may include (e.g. further include) at least one primary light passage 142 defining the at least one primary light path 141. According to various embodiments, the at least one primary light passage 142 may include at least one primary light-channelling-surface surrounding the at least one primary light path 141 (i.e. surrounding at least a portion or segment of, or an entire stretch / length of, the at least one primary light path 141) so that the at least one primary light-channelling-surface channels or directs light, emitted from the at least one main light source 131, (to be) within and/or along the at least one primary light path 141.

[00055] According to various embodiments, the light-channelling arrangement 140 may include (e.g. alternatively or further include) at least one auxiliary light passage 146 defining the at least one auxiliary light path 145. The at least one auxiliary light passage 146 may include at least one auxiliary light-channelling-surface surrounding the at least one auxiliary light path 145 (i.e. surrounding at least a portion or segment of, or an entire stretch / length of, the at least one auxiliary light path 145) so that the at least one auxiliary light-channelling-surface channels or directs the light, emitted from the at least one auxiliary light source 132, within and/or along the at least one auxiliary light path 145.

[00056] For example, according to various embodiments, the touch control module 100 (e.g. the light-channelling arrangement 140 of the touch control module 100) may include a light-isolating structure 150 (e.g. a plate or plate-like shaped light-isolating structure 150). The light-isolating structure 150 may be made of an opaque (or non-transparent or light-blocking or light-absorbing) material (or material composite). A non-limiting example of a material of the light-isolating structure 150 may be pigmented (e.g. black-colored or tinted)

polymer / plastic. The light-isolating structure 150 may be disposed between the touch plate 101 and the lighting arrangement 130 of the circuit assembly 110. The light-isolating structure 150 may include at least one primary through-hole 150a and/or at least one auxiliary through-hole 150b, respectively extending across the light-isolating structure 150 (e.g. along a thickness direction of the light-isolating structure 150). At least one inner surface (one or more inner surfaces, e.g. an opaque inner surface) of the at least one primary through-hole 150a of the light-isolating structure 150 may serve as at least a portion or segment of the at least one primary light-channelling-surface of the at least one primary light passage 142. At least one inner surface (one or more inner surfaces, e.g. an opaque inner surface) of the at least one auxiliary through-hole 150b of the light-isolating structure 150 may serve as at least a portion or segment of the at least one auxiliary light-channelling-surface of the at least one auxiliary light passage 146. Accordingly, according to various embodiments, the light-isolating structure 150, may be configured to isolate each light source 131, 132 (or light emitted from each light source 131, 132) from other light sources 131, 132 (or light emitted from other light sources 131, 132), thereby preventing light leakage from each light source 131, 132. For example, the light-isolating structure 150 may isolate light emitted from the at least one main light source 131 and light emitted from the at least one auxiliary light source 132 such that they do not mix or interfere with each other.

[00057] FIG. 2A shows an exploded perspective view of a first variant touch control module 200, according to various embodiments.

[00058] Referring to FIG. 2A, the touch control module 200 of FIG. 2A may, similar to the touch control module 100 of FIG. 1, include a touch plate 201, a circuit assembly 210, a light-channelling arrangement 240 (see FIG. 2B to FIG. 2D), and a light-isolating structure 250.

[00059] The components of the touch control module 200 of FIG. 2A to FIG. 2I that are like the corresponding components of the touch control module 100 of FIG. 1 are similarly numbered. The description of these components made with respect to the touch control module 200 of FIG. 2A to FIG. 2I may be applicable with respect to the touch control module 100 of FIG. 1, and vice versa.

[00060] Referring to FIG. 2A, the touch plate 201 may be a light transmissible pane. The light transmissible pane may be or may include, for example, a single (e.g. continuous) panel or piece of light transmissible glass. Similar to the touch plate 101 of FIG. 1, the light transmissible pane may include a plurality of primary light transmissible regions 202 and a

plurality of auxiliary light transmissible regions 203 (see FIG. 2B). According to various embodiments, the plurality of primary light transmissible regions 202 and the plurality of auxiliary light transmissible regions 203 may be disposed or arranged to be side-by-side along an inline axis 11a (e.g. a single and/or linear or straight axis or reference axis) extending along or across the light transmissible pane (i.e. touch plate 201).

[00061] As shown, at least a set of the plurality of primary light transmissible regions 202 and at least a set of the plurality of auxiliary light transmissible regions 203 may be arranged in an alternating arrangement (or order / sequence) with respect to each other. That is, for example, according to various embodiments, at least one primary light transmissible region 202 may be between a pair of neighboring auxiliary light transmissible regions 203, or vice versa, along the inline axis 11a.

[00062] The circuit assembly 210 may include a main circuit board 211 (e.g. a first circuit board) and/or an auxiliary circuit board 212 (e.g. a circuit board; or a second / another circuit board, in other words, a different or separate circuit board from the first circuit board).

[00063] Each of the main circuit board 211 and the auxiliary circuit board 212 may be or may include, for example, a printed circuit board (PCB), a flexible circuit board / flexible PCB, a rigid circuit board / rigid PCB, metal core circuit board / metal core PCB, etc.

[00064] At least one or both the main circuit board 211 and/or the auxiliary circuit board 212 may be (e.g. mostly or substantially or generally) made of an opaque (or non-transparent or light-blocking or light-absorbing) material (or material composite). For instance, the main circuit board 211 and/or the auxiliary circuit board 212 may be made of or may include any one or more of FR-4 (i.e. fiberglass-reinforced epoxy laminate, in other words, said circuit board may be a FR-4 / FR4 circuit board), phenolic paper, metal, opaque polymer (e.g. pigmented polymer), etc.

[00065] The main circuit board 211 and/or the auxiliary circuit board 212 may include a board-to-board connector 214 (e.g. electrical connector) (see FIG. 2F) and/or cable connector(s) to electrically connect (or that electronically connects) the main circuit board 211 and the auxiliary circuit board 212. The board-to-board connector 214 and/or the cable connector(s) may allow electrical communication between the main circuit board 211 and the auxiliary circuit board 212 (e.g. allow sensing signals to be transmitted from one circuit board to another circuit board).

[00066] The main circuit board 211 may include a component-face, that may be directed towards the touch plate 201, and an opposite connection-face. Similarly, the auxiliary circuit

board 212 may include a component-face, that may be directed towards the touch plate 201, and an opposite connection-face. As a non-limiting example, as shown in FIG. 2A, the component-face of the main circuit board 211 may be parallel (e.g. substantially parallel) with the component-face of the auxiliary circuit board 212. As another example (not shown), the component-face of the main circuit board 211 may be non-parallel (e.g. inclined / at an angle) with respect to the component-face of the auxiliary circuit board 212.

[00067] According to various embodiments, as shown in FIG. 2A, when the circuit assembly 210 includes both the main circuit board 211 and the auxiliary circuit board 212, the main circuit board 211 may be between (e.g. positioned or disposed between) the auxiliary circuit board 212 and the touch plate 201. That is, the auxiliary circuit board 212 may be behind or rearward of the main circuit board 211 along a direction (e.g. rearward direction) from the touch plate 201 to the main circuit board 211.

[00068] According to various embodiments, the circuit assembly 210 may, similar to the circuit assembly 110 of the touch control module 100 of FIG. 1, include a lighting arrangement 230.

[00069] The lighting arrangement 230 may include at least one main light source 231 (e.g. one or a plurality of main light sources 231) and at least one auxiliary light source 232 (e.g. one or a plurality of auxiliary light sources 232). The at least one main light source 231 may be disposed along a first alignment axis 12a which may be parallel to the inline axis 11a of the touch plate 201. The at least one auxiliary light source 232 may be disposed on a second alignment axis 13a (i.e. a different axis from the first alignment axis 12a and the inline axis 11a) which may be parallel to the inline axis 11a of the touch plate 201 and offset from the first alignment axis 12a. In other words, the first alignment axis 12a may be parallel with the second alignment axis 13a. Further, the second alignment axis 13a may be apart (e.g. non-coincident, and/or non-intersecting, etc.) with respect to the first alignment axis 12a. According to various embodiments, the second alignment axis 13a may be offset from the first alignment axis 12a in a direction perpendicular to the first alignment axis 12a.

[00070] For example, referring to FIG. 2A, according to various embodiments, the at least one main light source 231 and the at least one auxiliary light source 232 (e.g. all of said light sources) may be disposed on the component-face of auxiliary circuit board 212 (as such, the auxiliary circuit board 212 may serve or function as a “Backlight Circuit Board” or “Backlight PCB”). Each of the first alignment axis 12a and the second alignment axis 13a may be respectively extending along the component-face of the auxiliary circuit board 212

and may be parallel with the component-face of the auxiliary circuit board 212. In other words, the first alignment axis 12a and the second alignment axis 13a may lie along a same plane (e.g. reference plane) (e.g. parallel with the component-face of the auxiliary circuit board 212). The first alignment axis 12a and the second alignment axis 13a may be parallel with a longitudinal axis of the auxiliary circuit board 212. The second alignment axis 13a may be offset from the first alignment axis 12a in a direction that is substantially perpendicular to the longitudinal axis of the auxiliary circuit board 212 and that is extending along (or parallel with) a plane (e.g. reference plane) parallel with the component-face (e.g. planar / substantially planar or flat component-face) of the auxiliary circuit board 212 (or extending along / parallel with the component-face itself). Hence, when the touch control module 200 is in an upright or “use” orientation, the second alignment axis 13a may be above (e.g. directly above) the first alignment axis 12a.

[00071] Each of the at least one main light source 231 may be oriented in a manner such that a light emission direction of the at least one main light source 231 is along a first direction towards the touch plate 201. On the other hand, each of the at least one auxiliary light source 232 may be oriented in a manner such that a light emission direction of the at least one auxiliary light source 232 is along a second direction different from the first direction. As a non-limiting example, the second direction may be perpendicular (e.g. substantially perpendicular) to the first direction. For instance, when the touch control module 200 with the auxiliary circuit board 212 are in the upright or “use” orientation, the light emission direction of each of the at least one auxiliary light source 232 is “downwards”. Thus, according to various embodiments, the at least one main light source 231 may be at least one front-firing light source. On the other hand, the at least one auxiliary light source 232 may be at least one side-firing light source.

[00072] FIG. 2B is a close-up perspective view of a primary light passage 242 of an assembled touch control module 200 of FIG. 2A, according to various embodiments.

[00073] FIG. 2C and FIG. 2D are close-up perspective views of an auxiliary light passage 246 of an assembled touch control module 200 of FIG. 2A, according to various embodiments.

[00074] Referring to FIG. 2B and FIG. 2C, the light-channelling arrangement 240 may provide (or include / define) at least one primary light path 241 extending from the at least one main light source 231 to the at least one primary light transmissible region 202 and/or may provide (or include / define) at least one auxiliary light path 245 extending from the at

least one auxiliary light source 232 to the at least one auxiliary light transmissible region 203 of the touch plate 201.

[00075] According to various embodiments, the light-channelling arrangement 240 may include (e.g. further include) at least one primary light passage 242 defining the at least one primary light path 241. The at least one primary light passage 242 may include at least one primary light-channelling-surface surrounding the at least one primary light path 241 (i.e. surrounding at least a portion or segment of the at least one primary light path 241) so that the at least one primary light-channelling-surface channels (or directs) light, emitted from the at least one main light source 231, (to be) within and/or along the at least one primary light path 241. According to various embodiments, the light-channelling arrangement 240 may include (e.g. alternatively or further include) at least one auxiliary light passage 246 defining the at least one auxiliary light path 245. The at least one auxiliary light passage 246 may include at least one auxiliary light-channelling-surface surrounding the at least one auxiliary light path 245 (i.e. surrounding at least a portion or segment of the at least one auxiliary light path 245) so that the at least one auxiliary light-channelling-surface channels or directs light, emitted from the at least one auxiliary light source 232, within and/or along the at least one auxiliary light path 245.

[00076] Referring to FIG. 2A, the light-isolating structure 250 may be, but is not limited to being, sandwiched or disposed or interposed between (e.g. immediately or directly between) the main circuit board 211 and the auxiliary circuit board 212. The light-isolating structure 250 may include at least one primary through-hole 250a and/or at least one auxiliary through-hole 250b, extending across the light-isolating structure 250. At least one inner surface (or inner surface(s)) of the light-isolating structure 250 (e.g. defining or surrounding the at least one primary through-hole 250a of the light-isolating structure 250) may serve as at least a portion or segment of the at least one primary light-channelling-surface of the at least one primary light passage 242. At least one inner surface (or inner surface(s)) of the light-isolating structure 250 (e.g. defining or surrounding the at least one auxiliary through-hole 250b of the light-isolating structure 250) may serve as at least a portion or segment of the at least one auxiliary light-channelling-surface of the at least one auxiliary light passage 246. According to various embodiments, the light-isolating structure 250 may include at least one recess (e.g. at a rear side, or on or along a surface, e.g. rear surface, of the light-isolating structure 250 that is directed towards the connection-face of

the auxiliary circuit board 212) shaped to or for accommodating at least one light guide 270 (described in detail later).

[00077] Referring to FIG. 2B, the main circuit board 211 may include at least one primary through-hole 211a extending across the main circuit board 211 (e.g. along a thickness direction of the main circuit board 211).

[00078] At least one inner surface (or inner surface(s)) of the main circuit board 211 defining the at least one primary through-hole 211a of the main circuit board 211 may serve as at least another segment of the at least one primary light-channelling-surface of the at least one primary light passage 242. As the main circuit board 211 may be made of an opaque material (as previously mentioned), said inner surface (or surface(s)) of the main circuit board 211 may shield light, that passes through a respective primary through-hole 211a of the main circuit board 211, from reaching or radiating to or entering other through-hole(s) of the main circuit board 211 (e.g. another primary through-hole 211a and/or another auxiliary through-hole 211b of the main circuit board 211, described in detail later). In other words, said inner surface (or surface(s)) of the main circuit board 211 defining each of the at least one primary through-hole 211a of the main circuit board 211 may prevent light (i.e. that travels or radiates along a hole axis of the primary through-hole 211a) from travelling or radiating laterally or perpendicularly (e.g. prevent stray light) with respect to the hole axis of the primary through-hole 211a and across or through the inner surface(s) of the main circuit board 211 defining the primary through-hole 211a. As such, the touch control module 200 may achieve effective light isolation between adjacent light-transmissible regions 202, 203 on the touch plate 201 (e.g. at least a set of the plurality of primary light transmissible regions 202 and at least a set of the plurality of auxiliary light transmissible regions 203 arranged in an alternating arrangement, e.g. within a confined area or space).

[00079] Referring to 2B, the at least one primary through-hole 211a of the main circuit board 211 may be aligned with the at least one primary through-hole 250a of the light-isolating structure 250. More specifically, according to various embodiments, a hole axis of each of the at least one primary through-hole 211a of the main circuit board 211 may be parallel with and/or coincident with a hole axis of a corresponding primary through-hole 250a of the light-isolating structure 250. Accordingly, the inner surface(s) of the main circuit board 211 defining the primary through-hole(s) 211a of the main circuit board 211 may be (e.g. respectively) aligned (e.g. flushed) with the inner surface(s) of the light-isolating structure 250 defining the primary through-hole(s) 250a of the light-isolating structure 250.

[00080] Referring to FIG. 2C and FIG. 2D, the main circuit board 211 may include (e.g. further include) at least one auxiliary through-hole 211b extending across the main circuit board 211 (e.g. along the thickness direction of the main circuit board 211).

[00081] At least one inner surface (or inner surface(s)) of the main circuit board 211 defining the at least one auxiliary through-hole 211b of the main circuit board 211 may serve as at least another segment of the at least one auxiliary light-channelling-surface of the at least one auxiliary light passage 246. Further, said inner surface (or surface(s)) of the main circuit board 211 defining the at least one auxiliary through-hole 211b of the main circuit board 211 may shield light, that passes through a respective auxiliary through-hole 211b of the main circuit board 211, from reaching or radiating to or entering other through-hole(s) (e.g. another primary through-hole 211a and/or another auxiliary through-hole 211b) of the main circuit board 211 which are defining and/or surrounding other light path(s) (e.g. primary light path(s) 241 and/or auxiliary light path(s) 245). That is, said inner surface (or surface(s)) of the main circuit board 211 defining each the at least one auxiliary through-hole 211b of the main circuit board 211 may prevent light (i.e. that travels or radiates along a hole axis of the auxiliary through-hole 211b of the main circuit board 211) from travelling or radiating laterally or perpendicularly (e.g. prevent stray light) with respect to the hole axis of the auxiliary through-hole 211b and across or through the inner surface(s) of the main circuit board 211 defining the auxiliary through-hole 211b. As such, the touch control module 200 may achieve effective light isolation between adjacent light-transmissible regions 202, 203 on the touch plate 201 (e.g. at least a set of the plurality of primary light transmissible regions 202 and at least a set of the plurality of auxiliary light transmissible regions 203 arranged in an alternating arrangement, e.g. within a confined area or space).

[00082] Referring to FIG. 2C and FIG. 2D, the at least one auxiliary through-hole 211b of the main circuit board 211 may be aligned with the at least one auxiliary through-hole 250b of the light-isolating structure 250. More specifically, according to various embodiments, a hole axis of each of the at least one auxiliary through-hole 211b of the main circuit board 211 may be parallel with and/or coincident with a hole axis of a corresponding auxiliary through-hole 250b of the light-isolating structure 250. Accordingly, the inner surface(s) of the main circuit board 211 defining the auxiliary through-hole(s) 211b of the main circuit board 211 may be (e.g. respectively) aligned (e.g. flushed) with the inner surface(s) of the light-isolating structure 250 defining the auxiliary through-hole(s) 250b of the light-isolating structure 250.

[00083] As shown in FIG. 2C and FIG. 2D, according to various embodiments, the light-channelling arrangement 240 may include (e.g. further include) at least one light guide 270 fitted to the at least one auxiliary light passage 246 and optically coupled to the at least one auxiliary light source 232 to direct light, emitted from the at least one auxiliary light source 232, through the at least one auxiliary light passage 246 along the at least one auxiliary light path 245. The at least one light guide 270 may be a light transmissible body which may include a first longitudinal end, a second longitudinal end, and a side surface (e.g. a single continuous side surface, or a plurality of adjoining side surfaces) extending between the first longitudinal end and the second longitudinal end. Light that enters the first longitudinal end of the at least one light guide 270 may be transmitted across the light transmissible body and emitted out from the second longitudinal end. According to various embodiments, the side surface of the light transmissible body may be configured to internally reflect light that is transmitted across the light transmissible body. As an example, shown in FIG. 2C and FIG. 2D, according to various embodiments, the at least one light guide 270 may be at least one “L”-shaped (e.g. substantially “L”-shaped) light guide 270 (or a plurality of “L”-shaped light guides 270), with a first longitudinal end thereof optically coupled to the at least one auxiliary light source 232 so as to be capable of directly receiving light emitted from the at least one auxiliary light source 232 via the first longitudinal end of the at least one “L”-shaped light guide 270. A second (e.g. another, opposite) longitudinal end of the at least one “L”-shaped light guide 270 may be directed towards or fitted (e.g. at least partially inserted) into the at least one auxiliary light passage 246 (e.g. the at least one auxiliary through-hole 250b of the light-isolating structure 250). Light emitted from the at least one auxiliary light source 232 into the first longitudinal end of the at least one “L”-shaped light guide 270 may be reflected (e.g. internally reflected) by a chamfered and/or corner side wall (or surface, between the first longitudinal end and the second longitudinal end) of the at least one “L”-shaped light guide 270 to change a direction of the light within the at least one “L”-shaped light guide 270, such that the light can be emitted out from the second longitudinal end of the at least one “L”-shaped light guide 270 that is extending in a different direction from the first longitudinal end.

[00084] Referring to FIG. 2A, according to various embodiments, the touch control module 200 may include (e.g. further include) a light diffuser 260 positioned along (or in the path of) the at least one primary light path 241 and the at least one auxiliary light path 245. That is, light that travels or radiates along each of the at least one primary light path

241 and the at least one auxiliary light path 245 may pass through the light diffuser 260. For example, referring to FIG. 2A, the light diffuser 260 may be sandwiched or disposed or interposed between the lighting arrangement 230 and the touch plate 201. More particularly, for example, as shown, the light diffuser 260 may be sandwiched or disposed or interposed between (e.g. immediately or directly between) the main circuit board 211 and the touch plate 201. Accordingly, light, emitted from the lighting arrangement 230 to or through the light diffuser 260, may be evenly distributed by the light diffuser 260 for illuminating a corresponding light transmissible region 202, 203 of the touch plate 201.

[00085] As a non-limiting example, the light diffuser 260 may be a patterned light diffuser 260 with one or more “icons” (i.e. “pattern(s)”, e.g. icon patterns / logos) printed on the light diffuser 260 (e.g. onto one or more portion(s) of the light diffuser 260). Such pattern(s) may affect the way light, that passes through the light diffuser 260, is scattered (e.g. illuminated) onto the touch plate 201. The printed pattern(s) (also referred to as “printed icon(s)”) on the light diffuser 260 may create a light pattern on the touch plate 201 corresponding to the printed pattern(s), when light passes through the patterned light diffuser 260 towards the touch plate 201. As a non-limiting example, the printed pattern(s) or icon(s) may include any one or more of letter(s) of any alphabet, shapes (e.g. dots, circles, square, etc.), pictures or logos (e.g. power icon, brightness icon, mode icon, light temperature icon, etc.). As a non-limiting example, the light diffuser 260 may be made of a polymer material (e.g. Polyethylene terephthalate or PET).

[00086] According to various other embodiments, the printed pattern(s) or icon(s) may be printed on the touch plate 201 (e.g. on a rear surface of the touch plate 201).

[00087] Each printed pattern(s) or icon(s) on the touch plate 201 and/or the light diffuser 260 may be aligned with a corresponding light transmissible region (e.g. primary light transmissible region 202 or auxiliary light transmissible region 203).

[00088] FIG. 2E and FIG. 2F are schematic diagrams showing an example touch sensing arrangement 220 on a main circuit board 211aa, for the circuit assembly 210 of the touch control module 200 of FIG. 2A, according to various embodiments.

[00089] FIG. 2E shows a component-face (i.e. top surface) of the main circuit board 211aa, while FIG. 2F shows a connection-face (i.e. rear surface) of the main circuit board 211aa.

[00090] The main circuit board 211aa may be compatible with the touch control module 200. That is, description of components made with respect to the main circuit board 211aa may be applicable with respect to the main circuit board 211, and vice versa.

[00091] According to various embodiments, the circuit assembly 210 may, similar to the circuit assembly 110 of the touch control module 100 of FIG. 1, include the touch sensing arrangement 220 on the main circuit board 211 or 211aa.

[00092] With reference to FIG. 2E, according to various embodiments, the touch sensing arrangement 220 of the touch control module 200 may include a plurality of touch sensing elements 221 disposed on the main circuit board 211 or 211aa of the circuit assembly 210. For example, as shown in FIG. 2E, the plurality of touch sensing elements 221 may be disposed on the component-face of the main circuit board 211aa (i.e. that may be directed towards the touch plate 201). Accordingly, within an assembled touch control module 200, the plurality of touch sensing elements 221 may be directed towards the touch plate 201 for detecting or sensing an operator's touch on (or in close proximity to) one or more input receiving region(s) of the touch plate 201.

[00093] As an example, for ease of illustration, FIG. 2E shows the plurality of touch sensing elements 221 as a plurality of capacitive sensing elements. As shown in FIG. 2E, each of the plurality of touch sensing elements 221 may be on the component-face of the main circuit board 211aa. Further, as shown, each of the plurality of touch sensing elements 221 on the component-face of the main circuit board 211aa may have a shape (herein referred to as "pattern area"). The pattern area of each touch sensing element 221 may correspond to (in other words, may be directly associated with) a specific sensitivity setting (i.e. touch sensitivity setting) (or range of sensitivity settings) of the touch sensing element 221. For example, the sensitivity setting may be based on (e.g. determined by) a size of the pattern area, with a larger pattern area of a touch sensing element 221 corresponding to a higher touch sensitivity setting of the touch sensing element 221. Furthermore, different shapes of the pattern area may correspond to different sensitivity settings. In other words, size and/or shape of a pattern area of a touch sensing element 221 may have an impact on sensitivity (e.g. touch detection sensitivity) of the touch sensing element 221.

[00094] According to various embodiments, the touch sensing arrangement 220 may include a first set of at least one touch sensing element 221 each having a first sensitivity setting, a second set at least one touch sensing element 221 each having a second sensitivity setting, and/or a further set of at least one touch sensing element 221 each having another

(e.g. third) sensitivity setting, etc. For example, as shown in FIG. 2E, the touch sensing arrangement 220 may include touch sensing elements 221a, 221b, 221c, 221d having a first pattern area (i.e. circular or oval-shaped pattern area) of a first shape and/or size that corresponds to a first sensitivity setting. The touch sensing arrangement 220 may include (e.g. further include) a plurality of other touch sensing elements 221e, 221f, 221g having yet another shape and/or size of pattern area, for example, serrated or serration pattern areas. Each serrated pattern area of a corresponding touch sensing element 221e, 221f, 221g may correspond to a particular (or specific or unique) sensitivity setting. As shown, the touch sensing arrangement 220 may include three touch sensing elements 221e, 221f, 221g having differently shaped and/or sized serrated pattern areas from each other. Accordingly, the three touch sensing elements 221e, 221f, 221g may have different sensitivity setting from one another.

[00095] According to various embodiments, the touch sensing elements 221e, 221f, 221g having serrated pattern areas may be arranged side-by-side, or immediately adjacent, to each other. As shown, neighbouring (e.g. immediately adjacent) serrated patterns may have respective side edges with corresponding (e.g. mating or matching) outlines. Further, as shown, according to various embodiments, the touch sensing elements 221e, 221f, 221g having serrated pattern areas may be spaced apart from each other. In this manner, the touch sensing elements 221e, 221f, 221g having serrated pattern areas may be configured to detect an operator's touch on (or within a preset proximity of) a plurality of input receiving regions of the touch plate 201 corresponding to a same or similar type of function (e.g. to adjust a level or intensity, for example, of brightness of light) – for instance, as the operator swipes or slides a finger along the inline axis 11a of the touch plate 201 – while minimizing or eliminating cross-talk between adjacent touch sensing elements 221e, 221f, 221g and/or preventing false trigger(s). Accordingly, the touch sensing element(s) 221e, 221f, 221g having serrated pattern areas may be configured as a “slide bar section” of the touch plate 201.

[00096] According to various embodiments, all of the plurality of touch sensing elements 221 may be disposed along a direction parallel with the inline axis 11a (or may be aligned with the inline axis 11a itself). As least a pair of neighbouring (e.g. immediately adjacent) touch sensing elements 221 may be configured with different sensitivity settings from one another. For example, as shown, the two touch sensing elements 221b and 221e which are neighbouring each other, may have different sized and/or shaped serrated pattern areas,

corresponding to different sensitivity settings of the touch sensing elements 221b and 221e. Further, as shown, the touch sensing element 221g may have a different shape and/or size from the touch sensing element 221c, corresponding to different sensitivity settings of the touch sensing elements 221g and 221c.

[00097] In addition to the above, neighbouring (e.g. immediately adjacent) touch sensing elements 221 configured to detect an operator's touch on (or within close proximity to) neighbouring (e.g. immediately adjacent) input receiving regions corresponding to different types of functions may be spaced further apart from each other than neighbouring (e.g. immediately adjacent) touch sensing elements 221 (e.g. another pair of touch sensing elements 221) configured to detect an operator's touch on (or within close proximity to) neighbouring (e.g. immediately adjacent) input receiving regions corresponding to a same or similar type of function. For example, as shown, the touch sensing element 221b (which may be for sending sensing signal(s) for activating a function of "light temperature") may be spaced further apart from touch sensing element 221e as compared to the spacing between touch sensing elements 221e and 221f (which may both be for sending sensing signal(s) for activating the function of adjusting a "level" or an "intensity").

[00098] As a non-limiting example, the touch sensing element 221a may be configured for sending sensing signal(s) for activating a function of toggling between turning on and off the touch control module 200 (or an electronic device fitted with the touch control module 200). The touch sensing element 221b may be configured for sending sensing signal(s) for activating a function of adjusting a mode (e.g. light mode, or other type of mode) of the touch control module 200 (or the electronic device). The touch sensing element 221c may be configured for sending sensing signal(s) for activating a function of adjusting a brightness of light emitted from the touch control module 200 (or the electronic device). The touch sensing element 221d may be configured for sending sensing signal(s) for activating a function of adjusting a color (e.g. color temperature) of light emitted from the touch control module 200 (or the electronic device).

[00099] As an example, shown in FIG. 2E, each of touch sensing elements 221a, 221b, 221c, 221d may be surrounding a corresponding primary through-hole 211a of the main circuit board 211aa (or corresponding hole axis thereof, which may be aligned with a corresponding normal axis of a primary light transmissible region 202, e.g. in an assembled touch control module 200). Each of touch sensing elements 221e, 221f, 221g may be surrounding one or more auxiliary through-hole(s) 211b of the main circuit board 211aa (or

corresponding hole axis/axes thereof, which may respectively be aligned with a corresponding normal axis of an auxiliary light transmissible region 203).

[000100] Referring to FIG. 2F, the touch control module 200 (e.g. the circuit assembly 210 of the touch control module 200) may include (e.g. further include) a processor 213. The processor 213 may be coupled to the plurality of touch sensing elements 221 and may be configured to receive signals (e.g. sensing signals) from the plurality of touch sensing elements 221 and/or to control the plurality of touch sensing elements 221 (e.g. adjusting sensitivity setting(s), i.e. touch sensitivity settings, of any one or more or all of the touch sensing elements 221, as intended by an operator). Accordingly, according to various embodiments, the processor may function as or may include a touch sensing controller. According to various embodiments, the processor 213 may be disposed on the connection-face of the circuit board (i.e. opposite the plurality of touch sensing elements 221 on the component-face). The touch control module 200 (e.g. the circuit assembly 210 of the touch control module 200) may include (e.g. further include) an interconnect structure on the circuit board configured to or for enabling the plurality of touch sensing elements 221 (i.e. on the component-face of the circuit board) and the processor 213 (i.e. on the connection-face of the circuit board) to communicate with each other. For example, the interconnect structure may include at least one via (e.g. vertical conductive pathway extending across the circuit board, e.g. between the component-face and the connection-face of the circuit board), one or more signal line(s) (e.g. conductive trace(s) or path(s) on the component-face and/or connection-face of the circuit board), etc. Accordingly, according to various embodiments, sensing signal(s) from the touch sensing element(s) 221 (i.e. on the component-face of the circuit board) may be directly routed to the connection-face (e.g. to the processor 213 on the connection-face) through (or by way of) the interconnect structure (e.g. at least one via, etc.) to prevent or minimize cross-talk and achieve accurate sensing or detection (e.g. without false triggers).

[000101] As a non-limiting example, the main circuit board 211aa may be approximately 100 to 200 mm (e.g. 123 mm) in length, approximately 5 to 15 mm (e.g. 9 mm) in width, and approximately 0.5 to 2.0 mm (e.g. 1.6 mm) in thickness. Each touch sensing element 221a, 221b, 221c, 221d may be approximately 5 to 15 mm (e.g. 11.6 mm) in length, and approximately 4 to 14 mm (e.g. 8 mm) in width. A distance (or gap or spacing) between touch sensing element 221a and touch sensing element 221b, and/or a distance between touch sensing element 221c and touch sensing element 221d, and/or a distance between

touch sensing element 221b and touch sensing element 221e, and/or a distance between touch sensing element 221g and touch sensing element 221c, may be approximately 15 to 20 mm (e.g. 18 mm) apart.

[000102] FIG. 2G shows a rear perspective view of an assembled touch control module 200 of FIG. 2A, according to various embodiments.

[000103] FIG. 2H shows an exploded view of FIG. 2G, according to various embodiments.

[000104] Referring to FIG. 2A, FIG. 2H and FIG. 2G, the components of the touch control module 200 may be arranged in the following order (or sequence): touch plate 201, light diffuser 260 (i.e. when the touch control module 200 includes the light diffuser 260), main circuit board 211 (i.e. when the circuit assembly 210 includes the main circuit board 211), light-isolating structure 250 (i.e. when the touch control module 200 includes the light-isolating structure 250), the auxiliary circuit board 212 (i.e. when the circuit assembly 210 includes the auxiliary circuit board 212) with the lighting arrangement 230 on the auxiliary circuit board 212. Said order may be in a direction (e.g. rearward direction) from the rear side of the touch plate 201. That is, the light diffuser 260 may be behind (or adjacent or immediately adjacent to) the touch plate 201. The main circuit board 211 may be behind (or adjacent or immediately adjacent to) the light diffuser 260 (or the touch plate 201, e.g. when the touch control module 200 does not include the light diffuser 260). The light-isolating structure 250 may be behind (or adjacent or immediately adjacent to) the main circuit board 211. The lighting arrangement 230 (e.g. the at least one main light source 231 and the at least one auxiliary light source 232) may be behind (or adjacent or immediately adjacent to) the light-isolating structure 250 (or the main circuit board 211 or the light diffuser 260 or the touch plate 201). More particularly, the auxiliary circuit board 212 with the lighting arrangement 230 may be behind (or adjacent or immediately adjacent to) the light-isolating structure 250.

[000105] According to various embodiments, the abovesaid components of the touch control module 200 may be stacked and/or coupled together in said order (or sequence) to form an integrated module (i.e. touch control module 200) with a compact form factor. For example, the abovesaid components may be fixed together with hot-melt to form such a touch control module 200.

[000106] FIG. 2I shows the touch control module 200 of FIG. 2A fitted into a light bar 1000, according to various embodiments.

[000107] Referring to FIG. 2I, the touch control module 200 may be compatible with a light bar 1000 (e.g. a light bar for a computer monitor). More particularly, the touch control module 200 may be encased or housed within a housing (e.g. an aluminum body) 1001 of the light bar 1000.

[000108] According to various other embodiments, the touch control module 200 may be fitted or housed in (in other words, may be compatible with) other types of devices (e.g. computer tablets, computer monitors, touch screens, televisions, radios, handphones, or any other suitable electronic devices etc.). Thus, the touch control module 200 may be integrated into any suitable electronic device.

[000109] FIG. 3A shows an exploded perspective view of a second variant touch control module 300, according to various embodiments.

[000110] Referring to FIG. 3A, the touch control module 300 of FIG. 3A may, similar to the touch control module 100 of FIG. 1 and/or the touch control module 200 of FIG. 2A to FIG. 2I, include a touch plate 301, a circuit assembly 310, a light-channelling arrangement 340, and a light-isolating structure 350.

[000111] The components of the touch control module 300 of FIG. 3A to FIG. FIG. 3J that are like the corresponding components of the touch control module 100 of FIG. 1 and/or the touch control module 200 of FIG. 2A to FIG. 2I are similarly numbered. The description of these components made with respect to the touch control module 300 may be applicable with respect to the touch control module 100 of FIG. 1 and/or the touch control module 200 of FIG. 2A to FIG. 2I, and vice versa.

[000112] Referring to FIG. 3A, the touch plate 301 may include a light transmissible pane. For example, the light transmissible pane may be or may include a single (e.g. continuous) panel or piece of light transmissible glass. Similar to the touch plate 101 of FIG. 1, the light transmissible pane may include a plurality of primary light transmissible regions 302 and a plurality of auxiliary light transmissible regions 303 (see FIG. 3B and FIG. 3C). According to various embodiments, the plurality of primary light transmissible regions 302 and the plurality of auxiliary light transmissible regions 303 may be disposed or arranged to be side-by-side along an inline axis 11b (e.g. a single and/or linear or straight axis or reference axis) extending along or across the light transmissible pane (i.e. touch plate 301).

[000113] As shown, at least a set of the plurality of primary light transmissible regions 302 and at least a set of the plurality of auxiliary light transmissible regions 303 may be arranged in an alternating arrangement (or order) with respect to each other. That is, for

example, according to various embodiments, at least one primary light transmissible region 302 may be between a pair of neighboring auxiliary light transmissible regions 303, or vice versa, along the inline axis 11b.

[000114] The circuit assembly 310 may include a main circuit board 311 (e.g. a first circuit board) and/or an auxiliary circuit board 312 (e.g. a circuit board; or a second circuit board, in other words, a different or separate circuit board from the main circuit board 311, etc.). Each of the main circuit board 311 and the auxiliary circuit board 312 may be or may include, for example, a PCB, a flexible circuit board / flexible PCB, a rigid circuit board / rigid PCB, metal core circuit board / metal core PCB, etc.

[000115] At least one or both the main circuit board 311 and/or the auxiliary circuit board 312 may be (e.g. mostly or substantially or generally) made of an opaque (or non-transparent or light-blocking or light-absorbing) material (or material composite). For instance, the main circuit board 311 and/or the auxiliary circuit board 312 may be made of or may include any one or more of FR-4 (i.e. fiberglass-reinforced epoxy laminate, in other words, said circuit board may be a FR-4 / FR4 circuit board), phenolic paper, metal, opaque polymer (e.g. pigmented polymer), etc.

[000116] The main circuit board 311 and/or the auxiliary circuit board 312 may include a board-to-board connector (e.g. electrical connector) and/or cable connector(s) to electrically connect (or that electronically connects) the main circuit board 311 and the auxiliary circuit board 312. The board-to-board connector and/or the cable connector(s) may allow electrical communication between the main circuit board 311 and the auxiliary circuit board 312 (e.g. allow sensing signals to be transmitted from one circuit board to another circuit board).

[000117] The main circuit board 311 may include a component-face, that may be directed towards the touch plate 301, and an opposite connection-face. Similarly, the auxiliary circuit board 312 may include a component-face, that may be directed towards the touch plate 301, and an opposite connection-face. As a non-limiting example, as shown in FIG. 3A, the component-face of the main circuit board 311 may be parallel (e.g. substantially parallel) with the component-face of the auxiliary circuit board 312. As another example (not shown), the component-face of the main circuit board 311 may be non-parallel (e.g. inclined / at an angle) with respect to the component-face of the auxiliary circuit board 312.

[000118] According to various embodiments, as shown in FIG. 3A, when the circuit assembly 310 includes both the main circuit board 311 and the auxiliary circuit board 312, the main circuit board 311 may be between (e.g. positioned or disposed between) the

auxiliary circuit board 312 and the touch plate 301. That is, the auxiliary circuit board 312 may be behind or rearward of the main circuit board 311 along a direction (e.g. rearward direction) from the touch plate 301 to the main circuit board 311.

[000119] According to various embodiments, the circuit assembly 310 may, similar to the circuit assembly 110 of the touch control module 100 of FIG. 1, include a lighting arrangement 330.

[000120] The lighting arrangement 330 may include at least one main light source 331 (e.g. one or a plurality of main light sources 331) and at least one auxiliary light source 332 (e.g. one or a plurality of auxiliary light sources 332). The at least one main light source 331 may be disposed along a first alignment axis 12b which may be parallel to the inline axis 11b of the touch plate 301. The at least one auxiliary light source 332 may be disposed on a second alignment axis 13b (i.e. a different axis from the first alignment axis 12b and the inline axis 11b) which may be parallel to the inline axis 11b of the touch plate 301 and offset from the first alignment axis 12b. In other words, the first alignment axis 12b may be parallel with the second alignment axis 13b. Further, the second alignment axis 13b may be apart (e.g. non-coincident, and/or non-intersecting, etc.) with respect to the first alignment axis 12b. According to various embodiments, the second alignment axis 13b may be offset from the first alignment axis 12b in a direction perpendicular to the first alignment axis 12b.

[000121] For example, referring to FIG. 3A, according to various embodiments, the at least one main light source 331 may be disposed on the component-face of the main circuit board 311, and the at least one auxiliary light source 332 may be disposed on the component-face of the auxiliary circuit board 312. Accordingly, the first alignment axis 12b may be extending along and may be parallel with the component-face (e.g. planar / substantially planar or flat component-face) of the main circuit board 311, and the second alignment axis 13b may be extending along and may be parallel with the component-face (e.g. planar / substantially planar or flat component-face) of the auxiliary circuit board 312. In other words, the first alignment axis 12b may lie along and may be parallel with a first plane (e.g. a first reference plane) parallel with the component-face of the main circuit board 311 (or extending along / parallel with the component-face itself), and the second alignment axis 13b may lie along and may be parallel with a second plane (e.g. a second or another reference plane) parallel with the component-face of the auxiliary circuit board 312 (or extending along / parallel with the component-face itself). Said first reference plane and second reference plane may be non-coincident with each other. The first alignment axis 12b

and the second alignment axis 13b may be parallel with a longitudinal axis of the main circuit board 311 (i.e. that may be in front of the auxiliary circuit board 312, when in a “use” orientation of the touch control module 300). The second alignment axis 13b may be offset from the first alignment axis 12b in a direction that is substantially perpendicular to the longitudinal axis of the main circuit board 311 and may be extending into or across (e.g. perpendicular to) the component-face of the main circuit board 311. Thus, the second alignment axis 13b may be behind (e.g. directly behind) the first alignment axis 12b, along a direction (e.g. rearward direction) from the touch plate 301 (e.g. rear side of the touch plate 301) to the main circuit board 311. That is, the at least one auxiliary light source 332 may be rearward of the at least one main light source 331. In other words, the at least one main light source 331 may be forward of, i.e. closer to the touch plate 301 than, the at least one auxiliary light source 332.

[000122] Each of the at least one main light source 331 and each of the at least one auxiliary light source 332 (in other words, all of said light sources 331, 332) may be oriented in a manner such that a light emission direction of the at least one main light source 331 and a light emission direction of the at least one auxiliary light source 332 are along a same direction towards the touch plate 301. For example, according to various embodiments, all of the at least one main light source 331 and the at least one auxiliary light source 332 may be front-firing light sources.

[000123] FIG. 3B is a close-up perspective view of a primary light passage 342 of an assembled touch control module 300 of FIG. 3A, according to various embodiments.

[000124] FIG. 3C is a close-up perspective view of an auxiliary light passage 346 of an assembled touch control module 300 of FIG. 3A, according to various embodiments.

[000125] Referring to FIG. 3B and FIG. 3C, the light-channelling arrangement 340 may provide (or include / define) at least one primary light path 341 extending from the at least one main light source 331 to the at least one primary light transmissible region 302 and/or may provide (or include / define) at least one auxiliary light path 345 extending from the at least one auxiliary light source 332 to the at least one auxiliary light transmissible region 303 of the touch plate 301.

[000126] According to various embodiments, the light-channelling arrangement 340 may include (e.g. further include) at least one primary light passage 342 defining the at least one primary light path 341. The at least one primary light passage 342 may include at least one primary light-channelling-surface surrounding the at least one primary light path 341 (i.e.

surrounding at least a portion or segment of the at least one primary light path 341) so that the at least one primary light-channelling-surface channels or directs light, emitted from the at least one main light source 331, (to be) within and/or along the primary light path 341. According to various embodiments, the light-channelling arrangement 340 may include (e.g. alternatively or further include) at least one auxiliary light passage 346 defining the at least one auxiliary light path 345. The at least one auxiliary light passage 346 may include at least one auxiliary light-channelling-surface surrounding the at least one auxiliary light path 345 (i.e. surrounding at least a portion or segment of the at least one auxiliary light path 345) so that the at least one auxiliary light-channelling-surface channels or directs light, emitted from the at least one auxiliary light source 332, within and/or along the at least one auxiliary light path 345.

[000127] Referring to FIG. 3A, the light-isolating structure 350 may be, but is not limited to being, sandwiched or disposed or interposed between (e.g. immediately or directly between) the main circuit board 311 and the touch plate 301. As shown, the main circuit board 311 may be sandwiched or disposed or interposed between (e.g. immediately or directly between) the light-isolating structure 350 (or the touch plate 301) and the auxiliary circuit board 312. According to various embodiments, the light-isolating structure 350 may include at least one primary through-hole 350a and/or at least one auxiliary through-hole 350b, extending across the light-isolating structure 350. At least one inner surface (or inner surface(s)) of the light-isolating structure 350 (e.g. defining or surrounding the at least one primary through-hole 350a of the light-isolating structure 350) may serve as at least a portion or segment of the at least one primary light-channelling-surface of the at least one primary light passage 342. An inner surface (or inner surface(s)) of the light-isolating structure 350 (e.g. defining or surrounding the at least one auxiliary through-hole 350b of the light-isolating structure 350) may serve as at least a portion or segment of the at least one auxiliary light-channelling-surface of the at least one auxiliary light passage 346. According to various embodiments, the light-isolating structure 350 may include at least one recess (e.g. at a rear side or on or along a rear surface of the light-isolating structure 350 that is directed towards the connection-face of the main circuit board 311 or the auxiliary circuit board 312) shaped or for accommodating a light diffuser 360 (described below).

[000128] According to various embodiments, the touch control module 300 may include (e.g. further include) a light diffuser 360 positioned along (or in the path of) the at least one primary light path 341 and the at least one auxiliary light path 345. That is, light that travels

or radiates along each of the at least one primary light path 341 and the at least one auxiliary light path 345 may pass through the light diffuser 360. For example, referring to FIG. 3B, the light diffuser 360 may be sandwiched or disposed or interposed between the lighting arrangement 330 and the touch plate 301. More particularly, for example, as shown, the light diffuser 360 may be sandwiched or disposed or interposed between (e.g. immediately or directly between) the main circuit board 311 and the light-isolating structure 350. Accordingly, light, emitted from the lighting arrangement 330 to or through the light diffuser 360, may be evenly distributed by the light diffuser 360 for illuminating a corresponding light transmissible region 302, 303 of the touch plate 301.

[000129] As shown in FIG. 3B, the light diffuser 360 may be seated within (or fitted into) the at least one recess at the rear side or surface of the light-isolating structure 350.

[000130] Referring back to FIG. 3A, according to various embodiments, the light diffuser 360 may be a single, continuous structure. Accordingly, according to various embodiments, a single, continuous recess may be formed at the rear side or surface of the light-isolating structure 350 for accommodating the single, continuous light diffuser 360.

[000131] With reference to FIG. 3B, according to various embodiments, the light diffuser 360 may be shaped in a manner such that at least one protruding portion 361 of the light diffuser 360 is fitted into (e.g. partially or entirely fitted into or seated within) the at least one primary through-hole 350a of the light-isolating structure 350. Accordingly, light that travels or radiates along the at least one primary light path 341 may pass or radiate or transmit through and/or along (e.g. longitudinally along) the protruding portion 361 of the light diffuser 360. A free end of the protruding portion 361 of the light diffuser 360 may be, but is not limited to being, flush or level with a front side (or surface) of the light-isolating structure 350.

[000132] As a non-limiting example, the light diffuser 360 may be a patterned light diffuser 360 with one or more “icons” (i.e. “pattern(s)”, e.g. icon patterns / logos) printed on the light diffuser 360 (e.g. onto one or more portion(s) of the light diffuser 360). Such pattern(s) may affect the way light, that passes through the light diffuser 360, is scattered (e.g. illuminated) onto the touch plate 301. The printed pattern(s) (also referred to as “printed icon(s)”) on the light diffuser 360 may create a light pattern on the touch plate 301 corresponding to the printed pattern(s), when light passes through the patterned light diffuser 360 towards the touch plate 301. As a non-limiting example, the printed pattern(s) or icon(s) may include any one or more of letter(s) of any alphabet, shapes (e.g. dots, circles,

square, etc.), pictures or logos (e.g. power icon, brightness icon, mode icon, light temperature icon, etc.). As another non-limiting example, the light diffuser 360 may be made of a translucent or semi-transparent material (e.g. translucent polymer).

[000133] According to various other embodiments, the printed pattern(s) or icon(s) may be printed on the touch plate 301.

[000134] According to various embodiments, the light diffuser 360 may additionally be configured as a light guide. In other words, the light diffuser 360 may also function or serve as a light guide (i.e. in addition to being capable of light diffusion). For example, the light diffuser 360 may include or may be a light transmissible body with side surface(s) thereof capable of internally reflecting light that enters the light transmissible body. Accordingly, light that enters the light diffuser 360 (e.g. from a rear side or surface of the light diffuser 360) may be emitted out from the free end of the at least one protruding portion 361 of the light diffuser 360 (i.e. that is fitted into the primary through-hole 350a of the light-isolating structure 350). In other words, light emitted from the at least one main light source 331 on the component-face of the main circuit board 311 may (e.g. directly) pass or transmit or radiate through the light diffuser 360 to (e.g. and through) the printed pattern(s) or icon(s) on the light diffuser 360 / the touch plate 301. In this manner, light emitted from the at least one main light source 331 may have a wide angular distribution of light (e.g. wider angular distribution than light emitted from the at least one auxiliary light source 332 that is channelled or isolated by tubular portion(s) 352 of the light-isolating structure 350, described below), onto the touch plate 301.

[000135] Referring to FIG. 3C, the light-isolating structure 350 may include a plate portion 351 and at least one tubular portion 352 extending from the plate portion 351. As shown, a first end region of each of the at least one tubular portion 352 may be at or adjoining or abutting the plate portion 351. The at least one auxiliary through-hole 350b of the light-isolating structure 350 may extend along the plate portion 351 along a thickness direction of the plate portion 351 and also through the at least one tubular portion 352 along a longitudinal axis of the at least one tubular portion 352. Each of the at least one auxiliary through-hole 350b of the light-isolating structure 350 may serve as a hollow core of a corresponding tubular portion 352 of the light-isolating structure 350 and may be sized such that a second free end region thereof, opposite the first end region, may surround a corresponding auxiliary light source 332. For instance, a second free end (e.g. longitudinal end) of each tubular portion 352 (i.e. where a corresponding second free end region

terminates) may but abutting or interfacing the component-face of the auxiliary circuit board 312 while the corresponding second free end region of the tubular portion 352 surrounds a corresponding auxiliary light source 332 on the auxiliary circuit board 312. This manner of surrounding the at least one auxiliary light source 332 using the tubular portion(s) 352 (e.g. opaque tubular portion(s) 352) of the light-isolating structure 350 may prevent or minimize light leakage (e.g. lateral light leakage) from each auxiliary light source 332 to adjacent or neighbouring light path(s). As such, the touch control module 300 may achieve effective light isolation between adjacent light-transmissible regions on 302, 303 the touch plate 301 (e.g. at least a set of the plurality of primary light transmissible regions 302 and at least a set of the plurality of auxiliary light transmissible regions 303 arranged in an alternating arrangement, e.g. within a confined area or space).

[000136] As shown, the main circuit board 311 (i.e. positioned behind or rearward of the light-isolating structure 350) may include at least one opening 311c for (e.g. shaped to receive or accommodate) the at least one tubular portion 352 of the light-isolating structure 350 to extend thereacross. Hence, each of the at least one opening 311c of the main circuit board 311 may be a through-hole, extending across the main circuit board 311 (e.g. along a thickness direction of the main circuit board 311, e.g. between the component-face and the connection-face of the main circuit board 311). The at least one opening 311c of the main circuit board 311 may be aligned with the at least one auxiliary light source 332. In other words, each of the at least one opening 311c of the main circuit board 311 may be aligned with a corresponding auxiliary light source 332. In yet other words, an optical axis of each of the at least one auxiliary light source 332 may be extending across a corresponding opening 311c of the main circuit board 311 (or may be aligned or coincident with a hole axis of the corresponding opening 311c of the main circuit board 311). According to various embodiments, the second free end region of each of the at least one tubular portion 352 may extend into (or across) a corresponding opening 311c of the main circuit board 311 to surround a corresponding auxiliary light source 332 (as shown in FIG. 3C). Thus, at least one or both an inner surface of each of the at least one auxiliary through-hole 350b of the light-isolating structure 350 (or at least an inner surface of each of the at least one tubular portion 352 of the light-isolating structure 350) and/or an inner surface of each of the at least one opening 311c of the main circuit board 311 may serve as at least a portion or segment of the at least one auxiliary light-channelling-surface of the at least one auxiliary light passage 346.

[000137] According to various embodiments, a number of the tubular portion(s) 352 of the light-isolating structure 350 may be equal to a number of the auxiliary light source(s) 332 and/or a number of opening(s) 311c of the main circuit board 311 and/or a number of the auxiliary light path(s) 345 and/or a number of the auxiliary light transmissible region(s) 303 of the touch plate 301.

[000138] According to various embodiments, when the touch control module 300 includes the light diffuser 360, the light diffuser 360 may include at least one opening 361a for (e.g. shaped to receive or accommodate) the at least one tubular portion 352 of the light-isolating structure 350 to extend thereacross. Accordingly, each of the at least one opening 361a of the light diffuser 360 may be a through-hole, extending across the light diffuser 360 (e.g. along a thickness direction of the light diffuser 360). Further, the at least one opening 361a of the light diffuser 360 may be aligned with the at least one opening 311c of the main circuit board 311. Accordingly, when the touch control module 300 includes the light diffuser 360, a number of the tubular portion(s) 352 of the light-isolating structure 350 may be equal to a number of opening(s) 361a of the light diffuser 360.

[000139] FIG. 3D is a close-up view of a rectangular-shaped touch sensing element of the touch sensing arrangement 320 on the main circuit board 311 of the touch control module 300, according to various embodiments.

[000140] FIG. 3E is a close-up view of a circular-shaped touch sensing element of the touch sensing arrangement 320 on the main circuit board 311 of the touch control module 300, according to various embodiments.

[000141] FIG. 3F and FIG. 3G are schematic diagrams showing an example touch sensing arrangement 320 on a main circuit board 311aa, for the circuit assembly 310 of the touch control module 300 of FIG. 3A, according to various embodiments.

[000142] FIG. 3F shows a component-face (i.e. top surface) of the main circuit board 311aa, while FIG. 3G shows a connection-face (i.e. rear surface) of the main circuit board 311aa.

[000143] The main circuit board 311aa may be compatible with the touch control module 300. That is, description of components made with respect to the main circuit board 311aa may be applicable with respect to the main circuit board 311, and vice versa.

[000144] According to various embodiments, the circuit assembly 310 may, similar to the circuit assembly 110 of the touch control module 100 of FIG. 1, include a touch sensing arrangement 320 on the main circuit board 311 or 311aa.

[000145] With reference to FIG. 2F, according to various embodiments, the touch sensing arrangement 320 of the touch control module 300 may include a plurality of touch sensing elements 321 disposed on the main circuit board 311 or 311aa of the circuit assembly 310. For example, as shown in FIG. 3F, the plurality of touch sensing elements 321 may be disposed on the component-face (i.e. front surface) of the main circuit board 311aa (i.e. that may be directed towards the touch plate 301). Accordingly, within an assembled touch control module 300, the plurality of touch sensing elements 321 may be directed towards the touch plate 301 for detecting or sensing an operator's touch on (or in close proximity to) one or more input receiving region(s) of the touch plate 301.

[000146] As an example, for ease of illustration, FIG. 3F shows the plurality of touch sensing elements 321 as a plurality of inductive sensing elements (e.g. inductive coils or springs). According to various embodiments, sensitivity setting of each touch sensing element 321 may be based on (e.g. determined by) any one or more of a shape, size, and/or height (or thickness) of the touch sensing element 321. Thus, for example, touch sensing elements 321 with different shapes and/or sizes and/or heights may have different sensitivity settings from one another. For example, a touch sensing element 321 with a larger size may have increased "touching" sensitivity. Accordingly, in some embodiments, the one or more touch sensing elements 321 may be sized to be as big as a form factor of the touch control module 300 permits.

[000147] According to various embodiments, the touch sensing arrangement 320 may include, at least, a first set of at least one touch sensing element 321 each having a first sensitivity setting and a second set of at least one touch sensing element 321 each having a second sensitivity setting. For example, as shown in FIG. 3F, the touch sensing arrangement 320 may include touch sensing elements 321a, 321b, 321c, 321d having a first shape (e.g. circle or circular shape) that corresponds to a first sensitivity setting. The touch sensing arrangement 320 may further include a second set of touch sensing elements 321e, 321f, 321g, 321h, 321i, 321j having a second (e.g. different) shape (e.g. rectangle or rectangular shape) that corresponds to a second (e.g. another or different) sensitivity setting from the first set of touch sensing elements 321.

[000148] According to various embodiments, all of the plurality of touch sensing elements 321 may be disposed along a direction parallel with the inline axis 11b (or may be aligned with the inline axis 11b) (see FIG. 3A). At least a pair of neighbouring (e.g. immediately adjacent) touch sensing elements 321 may be configured with different sensitivity settings

from one another. For example, as shown, the touch sensing element 321b may have a different shape and/or size from the touch sensing element 321e, corresponding to different sensitivity settings of the touch sensing elements 321b and 321e.

[000149] According to various embodiments, touch sensing elements 321 configured to detect an operator's touch on (or within close proximity to) neighbouring (e.g. immediately adjacent) input receiving regions corresponding to different types of functions may be spaced further apart from each other than touch sensing elements 321 configured to detect an operator's touch on (or within close proximity to) neighbouring (e.g. immediately adjacent) input receiving regions (e.g. another pair of input receiving regions) corresponding to a same or similar type of function. For example, as shown, the touch sensing element 321b (which may be for sending sensing signal(s) for activating a function of "light temperature") may be spaced further apart from touch sensing element 321e as compared to the spacing between touch sensing elements 321e and 321f (which may both be for sending sensing signal(s) for activating the function of adjusting a "level" or an "intensity").

[000150] As a non-limiting example, the touch sensing element 321a may be configured for sending sensing signal(s) for activating a function of toggling between turning on and off the touch control module 300 (or an electronic device fitted with the touch control module 300). The touch sensing element 321b may be configured for sending sensing signal(s) for activating a function of adjusting a mode (e.g. light mode, or other type of mode) of the touch control module 300 (or the electronic device). The touch sensing element 321c may be configured for sending sensing signal(s) for activating a function of adjusting a brightness of light emitted from the touch control module 300 (or the electronic device). The touch sensing element 321d may be configured for sending sensing signal(s) for activating a function of adjusting a color (e.g. color temperature) of light emitted from the touch control module 300 (or the electronic device).

[000151] As an example, shown in FIG. 3F, each of touch sensing elements 321a, 321b, 321c, 321d may be surrounding a corresponding main light source 331 (or corresponding optical axis thereof, which may be aligned with a corresponding normal axis of a primary light transmissible region 302, e.g. in an assembled touch control module 300). Each of touch sensing elements 321e, 321f, 321g, 321h, 321i, 321j may be surrounding a corresponding opening 311c of the main circuit board 311aa (or corresponding hole axis thereof, which may be aligned with a corresponding normal axis of a primary light transmissible region 302).

[000152] Referring to FIG. 3G, the touch control module 300 (e.g. the circuit assembly 310 of the touch control module 300) may include (e.g. further include) at least one processor 313 (e.g. two processors 313). The at least one processor 313 may be coupled or connected to the plurality of touch sensing elements 321 and may be configured to receive signals (e.g. sensing signals) from the plurality of touch sensing elements 321 and/or to control the plurality of touch sensing elements 321 (e.g. adjusting sensitivity setting(s), i.e. touch sensitivity settings, of any one or more or all of the touch sensing elements 321, as intended by the operator). According to various embodiments, the at least one processor 313 may be disposed on the connection-face of the circuit board (i.e. opposite the plurality of touch sensing elements 321 on the component-face). The touch control module 300 (e.g. the circuit assembly 310 of the touch control module 300) may include (e.g. further include) an interconnect structure on the circuit board configured to or for enabling the plurality of touch sensing elements 321 (i.e. on the component-face of the circuit board) and the at least one processor 313 (i.e. on the connection-face of the circuit board) to communicate with each other. For example, the interconnect structure may include at least one via (e.g. vertical conductive pathway extending across the circuit board, e.g. between the component-face and the connection-face of the circuit board), one or more signal line(s) (e.g. conductive trace(s) or path(s) on the component-face and/or connection-face of the circuit board), etc. Accordingly, according to various embodiments, sensing signal(s) from the touch sensing element(s) 321 (i.e. on the component-face of the circuit board) may be directly routed to the connection-face (e.g. to the processor at least one 313 on the connection-face) through (or by way of) the interconnect structure (e.g. at least one via, etc.) to prevent or minimize cross-talk and achieve accurate sensing or detection (e.g. without false triggers).

[000153] As a non-limiting example, the main circuit board 311aa may be approximately 100 to 200 mm (e.g. 104 mm) in length, approximately 5 to 15 mm (e.g. 9 mm) in width, and approximately 0.5 to 2.0 mm (e.g. 1.6 mm) in thickness. Each touch sensing element 321a, 321b, 321c, 321d may have a radius of approximately 1 to 5 mm (e.g. 3.2 mm). Each touch sensing element 321e, 321f, 321g, 321h, 321i, 321j may be approximately 1 to 10 mm (e.g. 4 mm) x 2 to 9 mm (e.g. 2 mm) in dimensions. A distance (or gap or spacing) between touch sensing element 321a and touch sensing element 321b, or a distance between touch sensing element 321c and touch sensing element 321d, or a distance between touch sensing element 321b and touch sensing element 321e, or a distance between touch sensing element

321j and touch sensing element 321c, may be approximately 15 to 20 mm (e.g. 18 mm) apart.

[000154] FIG. 3H shows a rear perspective view of an assembled touch control module 300 of FIG. 3A, according to various embodiments.

[000155] FIG. 3I shows an exploded view of FIG. 3H, according to various embodiments.

[000156] Referring to FIG. 3A, 3I and FIG. 3H, the components of the touch control module 300 may be arranged in the following order: touch plate 301, light-isolating structure 350 (i.e. when the touch control module 300 includes the light-isolating structure 350), light diffuser 360 (i.e. when the touch control module 300 includes the light diffuser 360), main circuit board 311 (i.e. when the circuit assembly 310 includes the main circuit board 311) with at least one main light source 331 on the main circuit board 311, auxiliary circuit board 312 (i.e. when the circuit assembly 310 includes the auxiliary circuit board 312) with at least one auxiliary light source 332 on the auxiliary circuit board 312. Said order may be in a direction (e.g. rearward direction) from the rear side of the touch plate 301. That is, the light-isolating structure 350 may be behind (or adjacent or immediately adjacent to) the touch plate 301. The light diffuser 360 may be behind (or adjacent or immediately adjacent to) the light-isolating structure 350 (or the touch plate 301, e.g. when the touch control module 300 does not include the light-isolating structure 350). The main circuit board 311 may be behind (or adjacent or immediately adjacent to) the light diffuser 360 and/or the light-isolating structure 350 (or the touch plate 301). The auxiliary circuit board 312 may be behind (or adjacent or immediately adjacent to) the main circuit board 311.

[000157] According to various embodiments, the abovesaid components of the touch control module 300 may be stacked and/or coupled together in said order (or sequence) to form an integrated module (i.e. touch control module 300) with a compact form factor. For example, the abovesaid components may be fixed together with hot-melt to form such a touch control module 300.

[000158] FIG. 3J shows the touch control module 300 of FIG. 3A fitted into a light bar 1000, according to various embodiments.

[000159] Referring to FIG. 3J, the touch control module 300 may be compatible with a light bar 1000 (e.g. a light bar for a computer monitor). More particularly, the touch control module 300 may be encased or housed within a housing 1001 (e.g. an aluminum body) of the light bar 1000.

[000160] FIG. 4A shows a frontal perspective view of a light bar 4000 with a touch control module 400, according to various embodiments.

[000161] According to various embodiments, there may be provided the light bar 4000. The light bar 4000 may include a touch control module 400, which may be similar or identical to the touch control module 100 of FIG. 1A, or the touch control module 200 of FIG. 2A, or the touch control module 300 of FIG. 3A.

[000162] As shown, according to various embodiments, light bar 4000 may include a housing 4001 (e.g. an outer casing or body) that encloses or houses the touch control module 400. The housing 4001 may include an opening (e.g. at a front section of the housing 4001) for a touch plate 401 of the touch control module 400 to be exposed. According to various embodiments, the housing 4001 may be constructed from of a rigid material, such as a metal.

[000163] The touch control module 400 may include the touch plate 401 having a plurality of primary light transmissible regions 402 and a plurality of auxiliary light transmissible regions 403. According to various embodiments, the plurality of primary light transmissible regions 402 and the plurality of auxiliary light transmissible regions 403 may be disposed or arranged to be side-by-side along an inline axis 11c (e.g. a single and/or linear or straight axis or reference axis) extending along or across the touch plate 401. The touch plate 401 may be made of a light transmissible material, such as a transparent polymer or plastic, glass etc., for allowing light emitted from at least one main light source (not shown) and/or at least one auxiliary light source (not shown) within the light bar 4000 to be visible therefrom.

[000164] FIG. 4B shows a close-up view of the touch plate 401 of the touch control module 400 of the light bar 4000 of FIG. 4A, according to various embodiments.

[000165] According to various embodiments, the plurality of auxiliary light transmissible regions 403 and a sub-set (e.g. a first sub-set) of the plurality of primary light transmissible regions 402a may be associated with or configured as functional “touch buttons”. According to various other embodiments, another sub-set (e.g. a second or remaining sub-set) of the plurality of primary light transmissible regions 402b, may be associated with non-functional attributes, such as letters (of the alphabet), text (e.g. name or word), or symbols that convey a message. This second sub-set of the plurality of primary light transmissible regions 402b may be position, for instance, between the plurality of auxiliary light transmissible regions 403. Consequently, as shown in FIG. 4B, during a “functional” mode of the touch control module 400 (or the light bar 4000), in which touch interactions with the touch control module 400 is enabled, the plurality of auxiliary light transmissible regions 403 and the first

sub-set of the plurality of primary light transmissible regions 402a may be illuminated, while the second sub-set of the plurality of primary light transmissible regions 402b may be unlit.

[000166] Furthermore, referring back to FIG. 4A, according to various embodiments, the light bar 4000 may include at least one task light source 4080 which is connected to the touch control module 400. The at least one task light source 4080 may be encased within the housing 4001 and may be configured to illuminate an area beneath the housing 4001 of the light bar 4000. Accordingly, the at least one task light source 4080, within the housing 4001, may be oriented to face downwards of the housing 4001. Additionally, the housing 4001 may include at least one task light opening at a lower section of the housing 4001 that allows light which is emitted from the at least one task light source 4080 to illuminate the area beneath the housing 4001 of the light bar 4000. According to various embodiments, the housing 4001 may include (e.g. optionally or further include) a task light cover 4081 over the at least one task light opening, which may include or may be a plastic or a glass lens.

[000167] According to various embodiments, the touch control module 400, that is connected to the at least one task light source 4080, enables control over the at least one task light source 4080, allowing functions such as toggling the at least one task light source 4080 on/off, adjusting brightness, and/or modifying color temperature of the at least one task light source 4080, etc., particularly, by sensing a user's touch on the plurality of auxiliary light transmissible regions 403 and the first sub-set of the plurality of primary light transmissible regions 402a (i.e. which are configured as functional "touch buttons").

[000168] According to various embodiments, the housing 4001 of the light bar 4000 may include an attachment arrangement 4083 for releasably attaching the light bar 4000 to an external electronic device (not shown), such as a computer monitor. As an example, shown in FIG. 4A, the attachment arrangement 4083 may include a first (e.g. upper) member 4083a and a second (e.g. lower) member 4083b which are hingedly engaged with each other in a manner so as to be capable of clamping onto a portion of the electronic device (e.g. an upper portion of a computer monitor). Additionally, according to various embodiments, the attachment arrangement 4083 may include an engagement sub-arrangement which enables the second member 4083b to be releasably secured at multiple positions relative to the first member 4083a, for clamping electronic devices of various sizes. According to various other embodiments, the attachment arrangement 4083 may include a biasing element (e.g. a spring) which urges the second member 4083b towards the first member 4083a, for clamping onto the external device. According to various embodiments, the attachment

arrangement 4083 (e.g. the first member 4083a and the second member 4083b) may be made of a material such as a polymer or plastic, to prevent or minimize scratches on the electronic device.

[000169] Additionally, according to various embodiments, in order to enhance grip and prevent slippage, the attachment arrangement 4083 may include anti-slip pads 4083c (e.g. rubber pads) on surfaces of the first member 4083a and the second member 4083b that is configured to interface with corresponding surfaces of the electronic device.

[000170] FIG. 4C shows a rear perspective view of the light bar 4000 of FIG. 4A, according to various embodiments.

[000171] With reference to FIG. 4C, according to various embodiments, the housing 4001 of the light bar 4000 may be pivotably coupled to the attachment arrangement 4083 (e.g. to the first member 4083a of the attachment arrangement 4083). Accordingly, when the light bar 4000 is attached (e.g. clamped) to the external electronic device, via the attachment arrangement 4083, the attachment arrangement 4083 (e.g. both the first member 4083a and the second member 4083b) may be immovable relative to the electronic device, while the housing 4001 of the light bar 4000 and, in turn, a light emission direction of the at least one task light source 4080 within the housing 4001 may be movable (e.g. rotatable) relative to the electronic device.

[000172] According to various embodiments, the light bar 4000 may be configured to be selectively mounted to an external tripod (not shown). For example, referring to FIG. 4C, the attachment arrangement 4083 (e.g. the second member 4083b of the attachment arrangement 4083) may include a threaded receptacle 4083c (e.g. a threaded tripod nut) for threadedly attaching the attachment arrangement 4083 of the light bar 4000 onto an external tripod.

[000173] According to various embodiments, with reference to FIG. 4C, the light bar 4000 may include (e.g. optionally or further include) at least one ambient lighting arrangement 4084. The at least one ambient lighting arrangement 4084 may be encased within the housing 4001 and may be configured to illuminate an area overhead or rearward of the housing 4001 of the light bar 4000. Specifically, the at least one ambient lighting arrangement 4084 may include or may be a “Red-Green-Blue” (also known as “RGB”) lighting arrangement which may be capable of producing a wide range of colors (or color combinations) and creating various lighting effects. Additionally, the housing 4001 may include at least one ambient light opening that allows light which is emitted from the

ambient lighting arrangement 4084 to illuminate the area overhead or rearward of the housing 4001 of the light bar 4000. According to various embodiments, the housing 4001 may include (e.g. optionally or further include) at least one ambient light cover 4085 over the ambient light opening, which may include or may be a plastic or a glass lens.

[000174] FIG. 4D shows a close-up view of an end cap 4086 of the housing 4001 of the light bar 4000 of FIG. 4A, according to various embodiments.

[000175] According to various embodiments, with reference to FIG. 4A and FIG. 4D, the housing 4001 of the light bar 4000 may include a pair of end caps 4086 (e.g. side covers) at the longitudinal ends of the housing 4001. The end caps 4086 may be removably attached to the housing 4001 (e.g. a tubular-shaped housing), for example, via threaded engagement between the end caps 4086 and the housing 4001.

[000176] With reference to FIG. 4D, to improve grip on the end caps 4086, each end cap 4086 may be knurled (or included a knurled pattern or formation 4086a) on an exterior side surface (e.g. curved side surface) of the end cap 4086.

[000177] Referring back to FIG. 4C, the light bar 4000 may include a power cable 4087 (e.g. USB power cable, AC power cable, etc.) for connecting the light bar 4000 to an external power source (e.g. power from a running computer, wall outlet, etc.).

[000178] The touch control module of various embodiments may thus achieve effective lighting isolation between adjacent light sources within a (very) confined or tight space.

[000179] Various embodiments may also provide a touch control that minimizes or eliminates signal interference between different touch inputs, resulting in a better signal-to-noise ratio and increased accuracy in touch detection.

[000180] Various embodiments may provide a touch control module designed to fit within a small or constrained area of an electronic device's housing, such as a tube body of a light bar.

[000181] While the invention has been particularly shown and described with reference to specific embodiments, it should be understood by those skilled in the art that various changes, modification, variation in form and detail may be made therein without departing from the scope of the invention as defined by the appended claims. The scope of the invention is thus indicated by the appended claims and all changes which come within the meaning and range of equivalency of the claims are therefore intended to be embraced.

CLAIMS

1. A touch control module comprising:

a touch plate having at least one primary light transmissible region and at least one auxiliary light transmissible region side-by-side along an inline axis along the touch plate;

a circuit assembly comprising

a touch sensing arrangement disposed relative to the light transmissible touch plate for sensing a touch on the light transmissible touch plate, and

a lighting arrangement for selectively illuminating between the at least one primary light transmissible region and the at least one auxiliary light transmissible region of the touch plate, the lighting arrangement comprising

at least one main light source disposed along a first alignment axis parallel to the inline axis of the touch plate for illuminating the at least one primary light transmissible region of the touch plate, and

at least one auxiliary light source disposed along a second alignment axis parallel to the inline axis of the touch plate and offset from the first alignment axis for illuminating the at least one auxiliary light transmissible region of the touch plate; and

a light-channelling arrangement disposed between the lighting arrangement of the circuit assembly and the touch plate, the light-channelling arrangement providing at least one primary light path extending from the at least one main light source to the at least one primary light transmissible region and at least one auxiliary light path extending from the at least one auxiliary light source to the at least one auxiliary light transmissible region, wherein the light channelling assembly further shields the at least one primary light transmissible region from the at least one auxiliary light source and shields the at least one auxiliary light transmissible region from the at least one main light source.

2. The touch control module of claim 1,

wherein the light-channelling arrangement comprises at least one auxiliary light passage defining the at least one auxiliary light path, the at least one auxiliary light passage comprising at least one auxiliary light-channelling-surface surrounding the at least one auxiliary light path so that the at least one auxiliary light-channelling-surface channels light, emitted from the at least one auxiliary light source along the at least one auxiliary light path.

3. The touch control module of claim 2, wherein the light-channelling arrangement further comprises:

a light-isolating structure disposed between the touch plate and the lighting arrangement of the circuit assembly, the light-isolating structure comprising at least one auxiliary through-hole extending across the light-isolating structure;

wherein at least one inner surface of the at least one auxiliary through-hole of the light-isolating structure serves as at least a segment of the at least one auxiliary light-channelling-surface of the at least one auxiliary light passage.

4. The touch control module of claim 3, wherein the light-channelling arrangement further comprises:

at least one light guide fitted to the at least one auxiliary light passage and optically coupled to the at least one auxiliary light source to direct light, emitted from the at least one auxiliary light source, through the at least one auxiliary light passage along the at least one auxiliary light path.

5. The touch control module of claim 4,

wherein the circuit assembly comprises a main circuit board;

wherein the main circuit board comprises at least one auxiliary through-hole extending across the main circuit board, the at least one auxiliary through-hole of the main circuit board aligned with the at least one auxiliary through-hole of the light-isolating structure;

wherein at least one inner surface of the main circuit board of the at least one auxiliary through-hole of the main circuit board serves as at least another segment of the at least one auxiliary light-channelling-surface of the at least one auxiliary light passage.

6. The touch control module of claim 5,

wherein the circuit assembly further comprises an auxiliary circuit board;

wherein the main circuit board is disposed between the auxiliary circuit board and the touch plate;

wherein the at least one main light source and the at least one auxiliary light source are disposed on a component-face of the auxiliary circuit board that is directed towards the touch plate.

7. The touch control module of claim 3,

wherein the light-isolating structure comprises a plate portion and at least one tubular portion extending from the plate portion, a first end region of the at least one tubular portion being at the plate portion,

wherein the at least one auxiliary through-hole of the light-isolating structure extends along the plate portion along a thickness direction thereof and through the at least one tubular portion along a longitudinal axis thereof;

wherein a second free end region of the at least one tubular portion, opposite the first end region of the at least one tubular portion, surrounds the at least one auxiliary light source.

8. The touch control module of claim 7,

wherein the circuit assembly comprises a main circuit board and an auxiliary circuit board, the main circuit board disposed between the auxiliary circuit board and the touch plate;

wherein the at least one main light source is disposed on a component-face of the main circuit board that is directed towards the touch plate;

wherein the at least one auxiliary light source is disposed on a component-face of the auxiliary circuit board that is directed towards the touch plate;

wherein the main circuit board comprises at least one opening extending across the main circuit board and aligned with the at least one auxiliary light source;

wherein the second free end region of the at least one tubular portion extends into the at least one opening of the main circuit board to surround the at least one auxiliary light source.

9. The touch control module of claim 1,

wherein the second alignment axis is offset from the first alignment axis in a direction perpendicular to the first alignment axis.

10. The touch control module of claim 9,

wherein the circuit assembly comprises a circuit board;

wherein the at least one main light source and the at least one auxiliary light source are disposed on a component-face of the circuit board that is directed towards the touch plate.

11. The touch control module of claim 10,

wherein the at least one main light source is oriented in a manner such that a light emission direction of the at least one main light source is along a first direction towards the touch plate;

wherein the at least one auxiliary light source is oriented in a manner such that a light emission direction of the at least one auxiliary light source is along a second direction different from the first direction.

12. The touch control module of claim 11,
wherein the second direction is perpendicular to the first direction.

13. The touch control module of claim 11,
wherein the circuit assembly comprises a main circuit board and an auxiliary circuit board, the main circuit board disposed between the auxiliary circuit board and the touch plate;

wherein the at least one main light source is disposed on a component-face of the main circuit board that is directed towards the touch plate; and

wherein the at least one auxiliary light source is disposed on a component-face of the auxiliary circuit board that is directed towards the touch plate.

14. The touch control module of claim 13,
wherein the at least one main light source and the at least one auxiliary light source are oriented in a manner such that a light emission direction of the at least one main light source and a light emission direction of the at least one auxiliary light source are along a same direction towards the touch plate.

15. The touch control module of claim 1, further comprising:
a light diffuser disposed between the lighting arrangement and the touch plate;
wherein the light diffuser is configured to diffuse light, emitted from the lighting arrangement through the light diffuser, for evenly distributing the light to the touch plate for illuminating a corresponding light transmissible region of the touch plate.

16. The touch control module of claim 1,

wherein the touch sensing arrangement comprises a plurality of touch sensing elements, each touch sensing element disposed about a normal axis of a corresponding region of the at least one primary light transmissible region or the at least one auxiliary light transmissible region of the touch plate;

wherein at least a pair of neighbouring touch sensing elements of the plurality of touch sensing elements are configured with different sensitivity setting from one another.

17. The touch control module of claim 16,

wherein the plurality of touch sensing elements comprises a plurality of capacitive sensors or a plurality of induction sensors.

18. The touch control module of claim 16,

wherein the circuit assembly comprises a circuit board with a component-face that is directed towards the touch plate;

wherein the plurality of touch sensing elements are disposed on the component-face of the circuit board;

wherein the circuit assembly further comprises a processor for controlling the plurality of touch sensing elements, the processor disposed on a connection-face of the circuit board opposite the component-face of the circuit board;

wherein the circuit assembly further comprises an interconnect structure on the circuit board for enabling the plurality of touch sensing elements and the processor to communicate with each other.