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BACKLIT FINGER FEATURE RECOGNITION STRUCTURE

Abstract

A backlit finger feature recognition structure includes a feature sensor configured to sense a finger feature, a light guide member disposed surrounding the finger sensor, a circuit board assembly disposed corresponding to the light guide member and electrically connected to a lower side of the feature sensor, and an illuminant electrically connected to the circuit board assembly, wherein in a stacking direction, the illuminant does not overlap the feature sensor, and the light guide member guides light emitted from the illuminant to be emitted along the stacking direction.

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Background/Summary

CROSS-REFERENCE TO RELATED APPLICATION

[0001] This application claims the priority benefits of Taiwan patent application serial No. 114201636, filed on Feb. 18, 2025, and also claims the priority benefits of U.S. provisional application Ser. No. 63/555,921, filed Feb. 21, 2024, U.S. provisional application Ser. No. 63/645,229, filed May 10, 2024, and U.S. provisional application Ser. No. 63/658,535, filed Jun. 11, 2024. The entirety of the mentioned above patent applications is hereby incorporated by reference herein and made a part of this specification.

BACKGROUND OF THE INVENTION

1. Field of the Invention

[0002] The invention generally relates to a feature recognition structure. Particularly, the invention relates to a thinned type of backlit finger feature recognition structure.

2. Description of the Prior Art

[0003] Conventional backlit fingerprint recognition modules are usually connected to the system by means of a flexible printed circuit board (FPC). However, the outbound end of the FPC may block the light path. To address this problem, the rigid circuit board is divided into multiple pieces of circuit boards, which are respectively arranged in different areas of the FPC, and the multiple pieces of circuit boards are stacked on each other by bending or folding the FPC. However, the stacking of multiple pieces of circuit boards makes it difficult to smoothly reduce the thickness of the module, which is not conducive to the thinning design. Furthermore, due to the size limitation of the module itself, the bending (or folding) radius of the FPC is usually small, which easily causes damage to components or circuits, thereby causing reliability problems.

SUMMARY OF THE INVENTION

[0004] It is an object of the invention to provide a backlit finger feature recognition structure, which effectively reduces the overall thickness by not overlapping at least one illuminant with the feature sensor in the stacking direction.

[0005] It is another object of the invention to provide a backlit finger feature recognition structure, wherein the feature sensor is cut according to a specific design to form the retreat space for the illuminant and promote the space utilization without affecting the connection pad and the sensing function.

[0006] It is yet another object of the invention to provide a backlit finger feature recognition structure, wherein the light guide member is formed by one or more flat plates, facilitating the processability and manufacturability.

[0007] In an embodiment, the invention provides a backlit finger feature recognition structure, including a feature sensor configured to sense a finger feature, a light guide member disposed surrounding the feature sensor, a circuit board assembly disposed corresponding to the light guide member and electrically connected to a lower side of the feature sensor, and an illuminant electrically connected to the circuit board assembly, wherein in a stacking direction, the illuminant does not overlap the feature sensor, and the light guide member guides light emitted from the illuminant to be emitted along the stacking direction.

[0008] In another embodiment, the invention provides a backlit finger feature recognition structure, including a feature sensor configured to sense a finger feature, a light guide member disposed surrounding the feature sensor, a circuit board assembly disposed corresponding to the light guide member and electrically connected to a lower side of the feature sensor, and an illuminant

electrically connected to the circuit board assembly, wherein in a plane view, the illuminant is located between the light guide member and the feature sensor, and the light guide member guides light emitted from the illuminant to be emitted upward.

[0009] In an embodiment, the feature sensor has a non-quadrilateral cut shape to form a retreat space between the light guide member and the feature sensor, and the illuminant is located in the retreat space.

[0010] In an embodiment, the illuminant and the feature sensor are located at a same side of the circuit board assembly.

[0011] In an embodiment, the light guide member includes a plate body with an opening. The plate body is disposed on the circuit board assembly. The feature sensor and the illuminant are accommodated in the opening.

[0012] In an embodiment, the opening includes a first receiving slot and a second receiving slot. The first receiving slot is configured to accommodate the feature sensor. The second receiving slot extends from the first receiving slot and is configured to accommodate the illuminant.

[0013] In an embodiment, the light guide member is constituted by a plurality of detachable plate bodies.

[0014] In an embodiment, the light guide member includes a first plate body and a second plate body respectively located under and above the circuit board assembly. The first plate body and the second plate body respectively have a first opening and a second opening. The first opening allows a portion of the circuit board assembly to extend therethrough to outside of the light guide member. The feature sensor and the illuminant are accommodated in the second opening.

[0015] In an embodiment, the first plate body and the second plate body constitute the light guide member of an integral structure or a detachable structure.

[0016] In an embodiment, the backlit finger feature recognition structure further includes an additional illuminant electrically connected to the circuit board assembly, wherein the additional illuminant and the illuminant are located at a same surface or different surfaces of the circuit board assembly.

[0017] In an embodiment, the circuit board assembly is a flex-rigid composite circuit board including a flexible printed circuit board and at least one rigid circuit board. The feature sensor and the illuminant are disposed on and electrically connected to the at least one rigid circuit board.

[0018] In an embodiment, the backlit finger feature recognition structure further includes a base holder with an accommodation space and a slot. The accommodation space is configured to accommodate the feature sensor, the light guide member, the circuit board assembly, and the illuminant. The slot communicates with the accommodation space and allows the circuit board assembly to extend from the slot to outside of the base holder.

[0019] In an embodiment, the backlit finger feature recognition structure further includes a cover disposed on the base holder to cover the accommodation space. The cover has a light-permeable portion. In a light-output direction, the light guide member at least partially overlaps the light-permeable portion.

[0020] In an embodiment, the backlit finger feature recognition structure further includes an optical film disposed on a light-exit surface of the light guide member.

[0021] In an embodiment, the backlit finger feature recognition structure further includes a plurality of light-exit dots disposed at a side of the light guide member opposite to a light-exit surface of the light guide member.

[0022] In an embodiment, the illuminant is at least partially located in a region defined by extending lines of adjacent outmost sides of the feature sensor.

[0023] Compared with the prior art, the backlit finger feature recognition structure of the invention forms the retreat space between the light guide member and the feature sensor by the cutting design of the feature sensor to improve the space utilization, effectively reduce the overall thickness, and facilitate the thinning design without affecting the sensing function and electrical connection of the

feature sensor. Moreover, the backlit finger feature recognition structure of the invention has the light guide member formed by one or more flat plates, facilitating the processability and manufacturability of the light guide member.

Description

BRIEF DESCRIPTION OF THE DRAWINGS

[0024] FIG. 1 is a perspective view of the backlit finger feature recognition structure in a first embodiment of the invention.

[0025] FIGS. 2A and 2B are respectively a partial plane view and a partial cross-sectional view of FIG. 1 to show the relative positions of the feature sensor, the light guide member, and the illuminant.

[0026] FIG. 3 is a plane view of the feature sensor in an embodiment of the invention to show the cutting design of the feature sensor.

[0027] FIGS. 4A and 4B are respectively an assembly view and a disassembly view of the light guide member in an embodiment of the invention.

[0028] FIGS. 5A and 5B are respectively a partial plane view and a partial cross-sectional view of the circuit board assembly in an embodiment of the invention.

[0029] FIGS. 6A and 6B are respectively a partial cross-sectional view and a partial plane view of the backlit finger feature recognition structure in a second embodiment of the invention.

[0030] FIG. 6C is a plane view of the light guide member in another embodiment of the invention.

[0031] FIGS. 7A and FIG. 7B are partial cross-sectional views of the backlit finger feature recognition structure in a third embodiment of the invention from different viewing angles.

[0032] FIGS. 7C and 7D are respectively a top view and a bottom view of FIG. 7A.

[0033] FIG. 8 is a plane view of the light guide member in a further embodiment of the invention.

[0034] FIGS. 9A to 9D are respectively a perspective view, partially exploded top and bottom views, and a partial cross-sectional view in a fourth embodiment of the invention.

[0035] FIG. 10 is a perspective view of the base holder in an embodiment of the invention.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

[0036] The invention is related to a finger feature recognition structure, particularly to a thinned type of backlit finger feature recognition structure. The backlit finger feature recognition structure of the invention can be disposed on the keyboard or housing of an electronic device in a modular configuration, but not limited thereto. According to practical applications, the backlit finger feature recognition structure of the invention can be an independent feature recognition device, which is configured to provide the recognition result for further operations of other electronic devices.

[0037] Referring to FIG. 1 to FIG. 2B, FIG. 1 is a perspective view of the backlit finger feature recognition structure 10 in a first embodiment of the invention; FIGS. 2A and B are respectively a partial plane view and a partial cross-sectional view of FIG. 1 to show the relative positions of the feature sensor, the light guide member, and the illuminant. In an embodiment, the backlit finger feature recognition structure 10 includes a feature sensor 100, a light guide member 200, a circuit board assembly 300, and an illuminant 400. The feature sensor 100 is configured to sense the finger feature. The light guide member 200 is disposed surrounding the feature sensor 100. The circuit board assembly 300 is disposed corresponding to the light guide member 200 and electrically connected to the lower side of the feature sensor 100. The illuminant 400 is electrically connected to the circuit board assembly 300. In the stacking direction S, the illuminant 400 does not overlap the feature sensor 100, and the light guide member 200 guides light emitted from the illuminant 400 to be emitted along the stacking direction S.

[0038] Specifically, the feature sensor 100 can be a finger feature recognition chip, which is configured to extract the finger feature of the user for subsequent recognition. For example, the

finger feature can be a fingerprint and/or a finger-vein. The feature sensor **100** can be a capacitive, optical, or ultrasonic fingerprint (and/or finger-vein) extraction/recognition chip. The recognition processing unit and the storage unit (not shown) can be integrated at the feature sensor end or the system end. In an embodiment, the recognition processing unit and the storage unit are preferably integrated at the system end, such as the central processing unit (CPU) and the memory of the computer mother board, but not limited thereto. In another embodiment, the recognition processing unit and the storage unit can be integrated to the electronic device that is equipped with the backlit finger feature recognition structure **10**. As shown in FIG. 2A, the feature sensor **100** has a non-quadrilateral cut shape to form a retreat space (e.g. **101** of FIG. 3) between the light guide member **200** and the feature sensor **100**, and the illuminant **400** is preferably disposed in the retreat space **101**. From another aspect, in the plane view of FIG. 2A, the illuminant **400** is located between the light guide member **200** and the feature sensor **100**, and the illuminant **400** is preferably at least partially located in a region defined (or surrounded) by extending lines of adjacent outmost sides of the feature sensor **100** (e.g. the retreat space **101**).

[0039] Also referring to FIG. 3, FIG. 3 is a plane view of the feature sensor **100** in an embodiment of the invention to show the cutting design of the feature sensor **100**. Specifically, as shown in FIG. 3, when cutting the feature sensor **100**, it is typically cut into a smaller rectangular (or square) shaped chip. Since the user's pressing or contact usually occurs in the center of the chip, the surrounding corners (e.g. the location of the retreat space **101** shown by the dotted line in FIG. 3) become inefficient chip areas (e.g. areas of low sensing possibility) or even invalid chip areas (e.g. corners are non-sensing areas). The invention reduces one or more corner spaces (preferably at least two corner spaces) of the feature sensor **100** through a deliberate cutting design (e.g. the cutting design of arch-chamfer shown by the solid line in FIG. 3) and provides the retreat space **101** for disposing the illuminant **400**, thereby improving the space utilization. For example, the cutting design of the feature sensor **100** preferably reserves 85% to 95% of the chip area of the feature sensor **100** to form the chamfered corner(s), but not limited thereto. According to practical applications, the feature sensor **100** can be cut to obtain the maximum retreat space(s) without sacrificing the sensing performance and electrical connection of the feature sensor **100** (i.e., without damaging the connection pad **110**). As such, the retreat space **101** for arranging the illuminant **400** can be formed between the feature sensor **100** and the light guide member **200** without significantly increasing the size of the light guide member **200** or by maintaining or even reducing the size of the light guide member **200**. With such a design, the illuminant **400** and the feature sensor **100** can be arranged side by side, and it is not necessarily to arrange the illuminant **400** and the feature sensor **100** overlappingly in the vertical direction (or the stacking direction S), effectively reducing the overall thickness. In this embodiment, the feature sensor **100** is illustrated to be cut with four arch chamfered corners, but not limited thereto. In other embodiments, for example as shown in FIG. 6B, the corners of the feature sensor **100** can be beveled to have an octagonal shape.

[0040] The light guide member **200** can be made of any suitable optical materials and is configured to guide the light emitted from the illuminant **400** to be emitted upward along the stacking direction S for indicating the sensing area of the backlit finger feature recognition structure **10** (i.e., the location of the feature sensor **100**). Referring to FIG. 2A and FIG. 4A, FIG. 4A is a schematic view of the light guide member **200** in an embodiment. As shown in FIG. 2A and FIG. 4A, the light guide member **200** includes a plate body, and the plate body has an opening **210**. The plate body is disposed on the circuit board assembly **300**, and the feature sensor **100** and the illuminant **400** are accommodated in the opening **210**. From another aspect, the entire light guide member **200** is disposed on the circuit board assembly **300** to effectively reduce the possibility of hindering the light path by the circuit board assembly **300**. Specifically, the opening **210** is a through hole that penetrates through the plate body of the light guide member **200** in the thickness direction (or the stacking direction S). In this embodiment, the opening **210** may include a first receiving slot **212**

and a second receiving slot **214**. The first receiving slot **212** is configured to accommodate the feature sensor **100**. The second receiving slot **214** extends from the first receiving slot **212** and is configured to accommodate the illuminant **400**. The first receiving slot **212** preferably has a shape corresponding to the feature sensor **100**. The second receiving slot **214** preferably has a shape and number corresponding to the illuminant **400**. As shown in FIG. 2A, the light guide member **200** has four second receiving slots **214**, which are respectively disposed at four corners of the first receiving slot **212**, and the second receiving slot **214** preferably at least partially (or completely) corresponds to the retreat space **101** formed after the feature sensor **100** is cut. In other words, in the stacking direction S, the second receiving slot **214** at least partially overlaps the retreat space **101** of FIG. 3. In this embodiment, the second receiving slot **214** can be an elongated slot, which corresponds to the side edge (preferably the long side) of the illuminant **400**, so light emitted from the illuminant **400** can effectively enter the light guide member **200** from the adjacent sidewall of the second receiving slot **214**, which improves the utilization of light, but not limited thereto. According to practical applications, the first receiving slot **212** and the second receiving slot **214** can be integrated into an opening having a single geometric shape (such as but not limited to the square-shaped opening **210A** shown in FIG. 6B) to simplify the processing of the light guide member **200**.

[0041] Moreover, in an embodiment, the light guide member **200** is preferably formed by combining a plurality of detachable plate bodies, so each plate body can be a flat plate to facilitate the processability and manufacturability of the light guide member **200**. In addition, the light guide member **200** constituted by a plurality of detachable plate bodies can also enhance the flexibility of the assembly process of the backlit finger feature recognition structure **10**, but not limited thereto. According to practical applications, the plate body of the light guide member **200** can be a single component, so the light guide member **200** is a single flat plate having the opening **210**. Referring to FIGS. 4A and 4B, FIG. 4B is a disassembly view of the light guide member **200**. As shown in FIGS. 4A and 4B, in this embodiment, the light guide member **200** can be formed by combining two plate bodies **201**, **202**. The two plate bodies **201**, **202** can be substantially mirror-image components to simplify the number of components and the complexity of manufacturing, but not limited thereto. Depending on the design of the opening **210**, the plate bodies **201**, **202** can be different components without mirror-image relationship. Corresponding to the above design of the first receiving slot **212** and the second receiving slots **214**, the plate bodies **201**, **202** can be corresponding U-shaped components, and respectively have a first partial opening **212a** and a second partial opening **212b**. Each of the plate bodies **201**, **202** has two second receiving slots **214**, which are disposed at the corners of the first partial opening **212a** or the second partial opening **212b**. As shown in FIG. 4A, when the plate bodies **201**, **202** are disposed side by side and combined to form the light guide member **200**, the first partial opening **212a** and the second partial opening **212b** together form the first receiving slot **212**.

[0042] Referring FIGS. 5A and 5B, FIGS. 5A and 5B are respectively a partial plane view and a partial cross-sectional view of the circuit board assembly **300** in an embodiment of the invention. In an embodiment, the circuit board assembly **300** is preferably a flex-rigid composite circuit board including a flexible printed circuit board (FPC) **330** and one or more rigid circuit boards (e.g. **310**, **320**). The feature sensor **100** and the illuminant **400** are preferably disposed on the rigid circuit board. Specifically, the circuit board assembly **300** may include a plurality of functional circuit boards, and a plurality of rigid circuit boards (e.g. **310**, **320**) serving as the functional circuit boards are preferably connected through the flexible printed circuit board **330**. In other words, the flexible printed circuit board **330** is configured to carry and electrically connect the plurality of functional circuit boards. For example, the plurality of functional circuit boards can include a feature board **310** and an interface board **320** (shown in FIG. 1). The feature board **310** is disposed with the feature circuit, which is configured to be electrically connected to the feature sensor **100** and to output the feature signal sensed by the feature sensor **100**. The interface board **320** can have the

circuitry and the connector and is electrically connected to the feature board **310** and the system end (e.g. connected to the connection interface of the computer mother board) to output the feature signal to the system end, thereby achieving the function of finger feature recognition. Moreover, each functional circuit board can be implemented with one or more circuit boards, so the one or more circuit boards may have corresponding circuits to perform the function of the corresponding functional circuit board individually or in combination. As shown in FIG. 5B, in this embodiment, the feature board **310** may include an upper circuit board **311** and a lower circuit board **312**, which are respectively disposed on and connected to the upper side and the lower side of the flexible printed circuit board **330**. The upper circuit board **311** and the lower circuit board **312** may together have the functional circuit of the feature board **310**, and at least the upper circuit board **311** may further include a light source circuit. As such, the feature sensor **100** and the illuminant **400** can be disposed on the upper side of the feature board **310** and electrically connected to the upper circuit board **311**. For example, the upper circuit board **311** may have a contact **313**, and the connection pad **110** of the feature sensor **100** is electrically connected to the contact **313**. Moreover, one or more electronic devices **315** such as resistor, capacitor, electrostatic discharge (ESD) protection device (e.g. transient voltage suppressor, TSV) can be optionally disposed on the circuit board (e.g. the lower circuit board **312**) to provide the required electrical characteristics. In this embodiment, the illuminant **400** and the feature sensor **100** can be on a same side or a same surface of the circuit board assembly **300**, such as the upper side or the upper surface of the flexible printed circuit board **330**. Moreover, the illuminant **400** and the feature sensor **100** can be disposed on the same or different circuit boards at the same side, and the illuminant **400** does not overlap the feature sensor **100** in the stacking direction S. In this embodiment, the upper circuit board **311** or the lower circuit board **312** is illustrated as a single circuit board, but not limited thereto. In another embodiment, the upper circuit board **311** and/or the lower circuit board **312** can be implemented as a circuit structure with multiple side-by-side arranged or partially stacked circuit boards. In this embodiment, the flexible printed circuit board **330** preferably does not have a bending (or folding) section for stacking multiple circuit boards, so the stress induced by bending (or folding) the flexible printed circuit board **330** can be reduced, but not limited thereto. According to practical applications, the flexible printed circuit board **330** may have a bending (or folding) section to form a structure of multiple stacked circuit boards.

[0043] The illuminant **400** can be any suitable light source configured to provide light. For example, the illuminant **400** can be a single-chip or multiple-chip light emitting diode (LED), mini-LED, micro-LED, and the like. The illuminant **400** can be a side-lighting or five-face (e.g. upper/left/right/front/rear faces) lighting illuminant. As shown in FIG. 2A, in this embodiment, four illuminants **400** are respectively disposed in the second receiving slots **214** at four corners, but not limited thereto. In other embodiments, the number of the illuminant **400** may vary, multiple illuminants **400** can be disposed in a same second receiving slot **214**, and/or an additional illuminant can be disposed on the lower side of the circuit board assembly **300**. In other words, according to practical applications, multiple illuminants **400** can be located at the same or different surfaces of the circuit board assembly **300**, and at least one of the illuminants **400** does not overlap the feature sensor **100** in the stacking direction S to effectively reduce the overall thickness.

[0044] Referring to FIGS. 6A to 6C, FIGS. 6A and 6B are respectively a partial cross-sectional view and a partial plane view of the backlit finger feature recognition structure in a second embodiment of the invention, and FIG. 6C is a plane view of the light guide member **200A** in another embodiment of the invention. Hereinafter, the differences between this embodiment and the previous embodiment are described. For the same or similar details, please refer to the relevant description of the previous embodiment. As shown in FIGS. 6A to 6C, in this embodiment, the light guide member **200A** has a rectangular (or square) opening **210A**, so the feature sensor **100A** and the illuminant(s) **400** are together disposed in the opening **210A**. The light guide member **200A** is preferably formed by combining two plate bodies **203**, **204**. As shown in FIG. 6A, the light guide

member **200A** further includes a plurality of light-exit dots **220**. The light-exit dots **220** are disposed at a side of the light guide member **200A** opposite to the light-exit surface **230** (or the light-output direction) of the light guide member **200A**. For example, the top surface of the light guide member **200A** can be the light-exit surface **230**, and the light-exit dots **220** can be microstructures, which are arranged in a predetermined pattern and shape on the bottom surface of the light guide member **200A**. With the design of light-exit dots **220** on the light guide member **200A**, the light path can be controlled, so the light distribution can be more uniform, promoting the optical uniformity.

[0045] In this embodiment, the backlit finger feature recognition structure can further include an optical film **700**. The optical film **700** is preferably disposed on the light-exit surface **230** of the light guide member **200A** to enhance the uniformity of light output. For example, the optical film **700** can be a diffusion film or a light-permeable ink layer. The light-permeable ink layer can be a white ink layer, which is printed on the light-exit surface **230** of the light guide member **200A**, but not limited thereto. In this embodiment, the feature sensor **100A** is shaped as an octagon with beveled corners to provide the retreat spaces **101** for accommodating the illuminants **400**. Such a configuration can also achieve the effects of the previous embodiment, such as improving the space utilization, reducing the overall thickness, facilitating the processability and manufacturability of the light guide member **200A**.

[0046] Referring to FIGS. 7A to 7D, FIGS. 7A and FIG. 7B are partial cross-sectional views of the backlit finger feature recognition structure in a third embodiment of the invention from different viewing angles, and FIGS. 7C and 7D are respectively a top view and a bottom view of FIG. 7A. Hereinafter, the differences between this embodiment and the previous embodiments are described. For the same or similar details, please refer to the relevant description of the previous embodiments. As shown in FIGS. 7A to 7D, in this embodiment, the light guide member **200B** is a three-dimensional (or box-shaped) frame. The light guide member **200B** has a window **232a** on the sidewall. The window **232a** allows a portion of the circuit board assembly **300** to extend therethrough to outside of the light guide member **200B**. Specifically, referring to FIG. 8, FIG. 8 is a plane view of the light guide member **200B** in a further embodiment of the invention. In this embodiment, the light guide member **200B** can include a first plate body **201b** and a second plate body **202b**. The first plate body **201b** and the second plate body **202b** are respectively located under and above the circuit board assembly **300**. The first plate body **201b** and the second plate body **202b** respectively have a first opening **232** and a second opening **234**. The first opening **232** allows a portion of the circuit board assembly **300** to extend therethrough to outside of the light guide member **200B**. The feature sensor **100** and the illuminant **400** are disposed in the second opening **234**. For example, the first plate body **201b** and the second plate body **202b** both are flat plates. The first opening **232** has an opened ring shape, and the second opening **234** has a closed ring shape. When the light guide member **200B** is assembled, the second plate body **202b** is stacked on the first plate body **201b**, and the first opening **232** forms the window **232a** between the first plate body **201b** and the second plate body **202b**. The feature board **310** of the circuit board assembly **300** is located on and supported by the first plate body **201b**, and an end of the flexible printed circuit board **330** of the circuit board assembly **300** that carries the interface board **320** extends through the window **232a** to outside of the light guide member **200B** while the feature sensor **100** and the illuminant **400** are accommodated in the second opening **234**. In this embodiment, the first plate body **201b** and the second plate body **202b** of the light guide member **200B** are detachable to facilitate the processability and manufacturability of the light guide member **200B**, but not limited thereto. In other embodiments, the first plate body **201b** and the second plate body **202b** can be formed as an integral structure. In other words, the light guide member **200B** can be an integral structure or a detachable structure.

[0047] As shown in FIG. 7C, in this embodiment, the feature sensor **100B** can be cut at two corners (e.g. upper/lower left corners) to form the retreat spaces **101** (as described above) to accommodate

the illuminants **400a**. Additional illuminant(s) **400b** can be disposed at the corners that the feature sensor **100B** is remained uncut, to promote the brightness and uniformity of light. For example, the illuminants **400b** can be disposed on the lower side of the circuit board assembly **300** (e.g. on the lower circuit board **312** of the feature board **310**), and the first plate body **201b** preferably at least partially overlaps the illuminants **400b** in the stacking direction S, so the light emitted downward from the illuminants **400b** can be guided through the first plate body **201b** and the second plate body **202b** and emitted upward from the light-exit surface **230** of the second plate body **202b**.

[0048] It is noted that according to practical applications, the light-exit dots **220** and the optical film **700** can be selectively implemented in any of the previous embodiments, not limited to the embodiment shown in the drawings. Moreover, the cover **600** shown in FIG. 6A and FIG. 7A will be described below. Referring to FIGS. 9A to 9D, FIGS. 9A to 9D are respectively a perspective view, partially exploded top and bottom views, and a partial cross-sectional view in a fourth embodiment of the invention. As shown in FIGS. 9A to 9D, the backlit finger feature recognition structure of the invention can further include a base holder **500** and a cover **600**, so the backlit finger feature recognition structure **10** can form a modular structure (e.g. a backlit finger feature recognition module). The base holder **500** serves as the housing of the backlit finger feature recognition module and is configured to support components of the backlit finger feature recognition module. The cover **600** is correspondingly disposed on the base holder **500** and configured to provide a plane for the user's finger to place or press. Specifically, referring to FIG. 10, FIG. 10 is a perspective view of the base holder **500** in an embodiment of the invention. As shown in the figure, the base holder **500** has an accommodation space **510** and a slot **520**. The accommodation space **510** is configured to accommodate the feature sensor **100**, the light guide member **200**, the circuit board assembly **300**, and the illuminant **400**. The slot **520** is formed on the base holder **500** and communicates with the accommodation space **510** to allow the circuit board assembly **300** to extend from the slot **520** to outside of the base holder **500**. For example, the base holder **500** can be a housing with a hollow portion. The hollow portion can be the accommodation space **510**, and the sidewall of the housing around the accommodation space **510** is configured to surround the sidewalls of the components (e.g. the feature sensor **100**, the light guide member **200**, the circuit board assembly **300**). The slot **520** preferably penetrates through the bottom of the base holder **500** to serve as a channel communicating the accommodation space **510** with the external environment. When the circuit board assembly **300** is disposed on the base holder **500**, one end of the circuit board assembly **300** which overlaps the light guide member **200** in the stacking direction S (i.e. the end including the feature board **310**) is located in the accommodation space **510**, and the other end of the circuit board assembly **300** which extends out from the light guide member **200** (i.e., the end including the interface board **320**) can extend downward through the slot **520** to outside of the base holder **500** and then is connected to the system end. In this embodiment, the base holder **500** preferably has a shape corresponding to the shape of the light guide member **200** and the feature board **310**, such as rectangular (or square) shape, but not limited thereto. According to practical applications, the base holder **500** can have any suitable shape, such as circular, polygonal, and other geometric shapes. The base holder **500** can further include a positioning portion **530**, which is configured to be combined with the electronic device. For example, the positioning portion **530** can be implemented as a rod, which extends outward from the bottom of the housing and is inserted into the hole of the electronic device to achieve the positioning effect, but not limited thereto. The base holder **500** can be positioned on the electronic device by any means as appropriate.

[0049] The cover **600** is disposed on the base holder **500** to cover the accommodation space **510**. The cover **600** preferably has a light-permeable portion **610**. In the stacking direction S (or light-output direction), the light guide member **100** at least partially overlaps the light-permeable portion **610**. From another aspect, the orthographic projection of the light guide member **200** on the cover **600** preferably at least partially overlaps the light-permeable portion **610**. Specifically, the cover

600 can be a plate made of glass, polymers, for example. The cover **600** is preferably connected to the feature sensor **100** through an adhesive material, so the cover **600** and the base holder **500** have an integral outer appearance, but not limited thereto. In an embodiment, the entire cover **600** can be the light-permeable portion **610**, but not limited thereto. As shown in FIG. **9B**, in this embodiment, the light-permeable portion **610** is preferably a ring-shaped band (e.g. square ring) formed on the periphery of the cover **600**. When the light guide member **200** guides the light of the illuminant **400** upward to emit from the top surface of the light guide member **200** (i.e., the light-exit surface **230** mentioned above), light can be substantially emitted from the light-permeable portion **610** to form a ring-shaped light pattern around the feature sensor **100**, which not only indicates the location of the sensing areas to the user, but also enhances the optical effect of the appearance.

[0050] It is noted that FIGS. **9A** to **9D** illustrate the backlit finger feature recognition structure **10** of FIG. **1** is disposed in the base holder **500**, but not limited thereto. In other embodiments, the backlit finger feature recognition structure of any of the previous embodiments can be disposed in the base holder **500** to form the modular structure.

[0051] Although the preferred embodiments of the invention have been described herein, the above description is merely illustrative. The preferred embodiments disclosed will not limit the scope of the invention. Further modification of the invention herein disclosed will occur to those skilled in the respective arts and all such modifications are deemed to be within the scope of the invention as defined by the appended claims.

Claims

1. A backlit finger feature recognition structure, comprising: a feature sensor configured to sense a finger feature; a light guide member disposed surrounding the feature sensor; a circuit board assembly disposed corresponding to the light guide member and electrically connected to a lower side of the feature sensor; and an illuminant electrically connected to the circuit board assembly, wherein in a stacking direction, the illuminant does not overlap the feature sensor, and the light guide member guides light emitted from the illuminant to be emitted along the stacking direction.
2. The backlit finger feature recognition structure of claim 1, wherein the feature sensor has a non-quadrilateral cut shape to form a retreat space between the light guide member and the feature sensor, and the illuminant is located in the retreat space.
3. The backlit finger feature recognition structure of claim 1, wherein the illuminant and the feature sensor are located at a same side of the circuit board assembly.
4. The backlit finger feature recognition structure of claim 1, wherein the light guide member comprises a plate body with an opening; the plate body is disposed on the circuit board assembly; the feature sensor and the illuminant are accommodated in the opening.
5. The backlit finger feature recognition structure of claim 4, wherein the opening comprises a first receiving slot and a second receiving slot; the first receiving slot is configured to accommodate the feature sensor; the second receiving slot extends from the first receiving slot and is configured to accommodate the illuminant.
6. The backlit finger feature recognition structure of claim 4, wherein the light guide member is constituted by a plurality of detachable plate bodies.
7. The backlit finger feature recognition structure of claim 1, wherein the light guide member comprises a first plate body and a second plate body respectively located under and above the circuit board assembly; the first plate body and the second plate body respectively have a first opening and a second opening; the first opening allows a portion of the circuit board assembly to extend therethrough to outside of the light guide member; the feature sensor and the illuminant are accommodated in the second opening.
8. The backlit finger feature recognition structure of claim 7, wherein the first plate body and the second plate body constitute the light guide member of an integral structure or a detachable

structure.

9. The backlit finger feature recognition structure of claim 1, further comprising an additional illuminant electrically connected to the circuit board assembly, wherein the additional illuminant and the illuminant are located at a same surface or different surfaces of the circuit board assembly.

10. The backlit finger feature recognition structure of claim 1, wherein the circuit board assembly is a flex-rigid composite circuit board including a flexible printed circuit board and at least one rigid circuit board; the feature sensor and the illuminant are disposed on and electrically connected to the at least one rigid circuit board.

11. The backlit finger feature recognition structure of claim 1, further comprising a base holder with an accommodation space and a slot; the accommodation space is configured to accommodate the feature sensor, the light guide member, the circuit board assembly, and the illuminant; the slot communicates with the accommodation space and allows the circuit board assembly to extend from the slot to outside of the base holder.

12. The backlit finger feature recognition structure of claim 11, further comprising a cover disposed on the base holder to cover the accommodation space; the cover has a light-permeable portion; in a light-output direction, the light guide member at least partially overlaps the light-permeable portion.

13. The backlit finger feature recognition structure of claim 1, further comprising an optical film disposed on a light-exit surface of the light guide member.

14. The backlit finger feature recognition structure of claim 1, further comprising a plurality of light-exit dots disposed at a side of the light guide member opposite to a light-exit surface of the light guide member.

15. The backlit finger feature recognition structure of claim 1, wherein the illuminant is at least partially located in a region defined by extending lines of adjacent outmost sides of the feature sensor.

16. A backlit finger feature recognition structure, comprising: a feature sensor configured to sense a finger feature; a light guide member disposed surrounding the feature sensor; a circuit board assembly disposed corresponding to the light guide member and electrically connected to a lower side of the feature sensor; and an illuminant electrically connected to the circuit board assembly, wherein in a plane view, the illuminant is located between the light guide member and the feature sensor, and the light guide member guides light emitted from the illuminant to be emitted upward.

17. The backlit finger feature recognition structure of claim 16, wherein the illuminant is at least partially located in a region defined by extending lines of adjacent outmost sides of the feature sensor.

18. The backlit finger feature recognition structure of claim 16, wherein the illuminant and the feature sensor are located at a same side of the circuit board assembly.

19. The backlit finger feature recognition structure of claim 16, wherein the light guide member comprises a plate body with an opening; the plate body is disposed on the circuit board assembly; the feature sensor and the illuminant are accommodated in the opening.

20. The backlit finger feature recognition structure of claim 19, wherein the light guide member is constituted by a plurality of detachable plate bodies.
