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User Interface Display on Spine of Foldable Electronic Device

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User Interface Display on Spine of Foldable Electronic Device

Abstract:

This publication describes systems and techniques to provide a display on a spine of a foldable electronic device, such as a smartphone. While in a folded state, a foldable electronic device has an internal surface and an external surface. The external surface includes an area resembling a spine of a closed hardback book. If a display screen is incorporated at the internal surface, a user cannot see the screen while the device is closed. If a display screen is incorporated at the external surface, a user cannot discreetly view the display to see incoming notifications. To ameliorate these issues by enabling a user to have discreet interaction with an electronic device while in a folded state, the spine of the device is utilized as a display. A spine display can provide text, graphics, and other information to a user of the electronic device as part of a user interface (UI). If a "primary" display screen is disposed on an internal surface of a device in a folded state, a spine display can be implemented as an "auxiliary" display screen. If a display screen is disposed on an external surface of a folded device, a spine display can be implemented as a segment of the display screen. The spine display can discreetly provide notifications to a user without physical interaction with the device. Alternatively, the user can interact with the spine display via touch, such as with a thumb, to scroll through various notifications or deactivate an alert. In some cases, a user can customize the functionality of the spine display—e.g., using an operating system feature.

Keywords:

electronic device, smartphone, foldable device, bendable display, flexible display, spine, hinge, user interface (UI), swipe, scroll, auxiliary display, secondary display, notification, alert

Background:

Many users prefer a larger display screen on a portable electronic device because larger screens enable a user to see and interact with more content for greater productivity or for a more enjoyable viewing experience. Further, larger-sized content can be presented on a larger screen to help with visual difficulties, such as eye fatigue or myopia. Manufacturers have therefore increased display screen sizes of electronic devices over time. However, people also generally prefer smaller form factors for convenience and increased portability. To address these two conflicting preferences—both larger display screens and smaller form factors, electronic devices can be manufactured with foldable screens. To do so, a flexible display technology is mated to a device that includes a hinged area.

While in a folded state, an electronic device with two folded portions includes an internal surface between the two folded portions and an external surface that wraps around an outside of the two folded portions. If a display screen is disposed on the external surface, a user cannot discreetly check content that may be presented on the folded display screen or casually interact with the content. If, on the other hand, the display screen is disposed on the internal surface of the device, the user is unable to see the display screen at all while the device is folded. It can therefore be challenging for a user to interact with a foldable electronic device while the device is in a folded state.

Thus, it is desirable to provide a mechanism, such as an apparatus or a technique, that enables a user to discreetly and conveniently interact with a foldable electronic device while the device is in a folded state.

Description:

This publication describes apparatuses and techniques for providing a mechanism that enables a user to interact with a foldable electronic device while the device is in a folded state using a spine display, which is described herein. To do so, a flexible display technology can be mated to a device that includes two portions and a hinge part. The hinge part results in an area resembling a spine of a closed hardback book. The spine is utilized as a display screen while the electronic device is in a folded state. This spine display is used to present notifications to a user and to enable the user to interact with the spine display as another display-based UI of the device.

Fig. 1 below illustrates an example electronic device including a spine display.

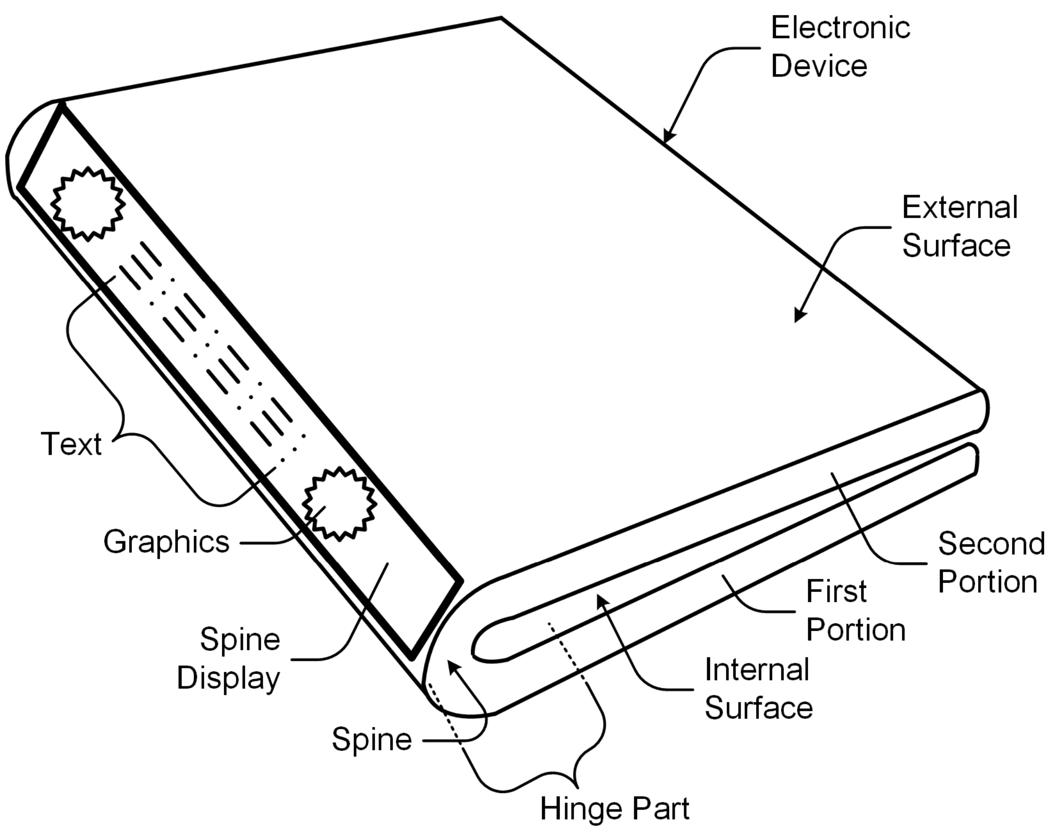

Fig. 1

As shown, the electronic device includes a first portion, a second portion, and a hinge part. The electronic device can be implemented as, for example, a smartphone, a tablet or slate computer, a convertible notebook computer, an information display, a sensor or security interface device, a personal digital assistant (PDA), an entertainment device for reading or viewing videos, and so forth. At least one of the two portions can rotate relative to the other portion about the hinge part—e.g., with the hinge part acting as a rotational axis for the first portion of the device. If in an unfolded state, the device can be substantially flat with first and second sides of a display screen being parallel to each other within a common plane. If the device is in a folded state, the first and second portions and an inner section of the hinge part create an internal surface. The two portions and an outer section of the hinge part create an external surface. At least while folded, the external surface of the electronic device includes a spine at the hinge part.

In example implementations, the electronic device includes a display on the spine, which is called a "spine display" herein. Generally, a display screen can be disposed on the internal surface or the external surface of the electronic device (or both). If a "primary" display screen is disposed on the internal surface of the device in a folded state, the spine display can be implemented as an "auxiliary" display screen. Thus, the spine display may be implemented as a second, separate display screen. On the other hand, if a display screen is disposed on the external surface of the device in a folded state, the spine display can be implemented as a segment of this display screen. In this case, segments of the display screen that extend over the first and second portions can be unpowered, dark, or otherwise inactive while a segment having the spine display is in use. Generally, the spine display can be realized using a liquid crystal display (LCD), a light-emitting diode (LED) display, an organic light-emitting diode (OLED) display, and so forth. In some implementations, at least the spine display is formed from a flexible display material, such as a flexible plastic substrate that supports OLEDs. Screens or screen segments corresponding to the first and second portions may be realized using rigid or flexible materials.

As shown, the electronic device can be placed on a table or countertop, secured to a vertical surface, held in a hand, and so forth. Without further manipulation of the device, a user can visually receive notifications that are presented on the spine display discreetly without interrupting a conversation or a meeting. There is no need for the user to open or physically interact with the device. The device can employ an accelerometer to rotate displayed contents to be oriented “up” in relation to the ground as the device is moved around for easy reading. Further, the electronic device can be manufactured to have a portable size, such as one that fits in a hand or on a lap. An example implementation of a hand-sized device is depicted in Fig. 2 below. An axis along the hinge part can enable folding in a horizontal or a vertical direction, depending on implementation design or current orientation (e.g., landscape or portrait mode). Although depicted with a curved spine in Fig. 1, a spine display can alternatively be implemented with a flat spine.

The spine display can present one or more images responsive to at least one detected stimulus. Examples of a stimulus include movement of the device, touching part of any display screen, touching the spine display (e.g., but touching other parts of the display do not serve as a stimulus), a defined touch gesture or swipe, and so forth. Thus, the spine display can be in an always-on mode (e.g., if the device is closed) or a wake-on-demand mode. The spine display can present text, graphics, scrolling text or images, videos, and so forth. A user can therefore be provided important notifications—e.g., information that is relevant to near-future activities or obligations—without directly interacting with the electronic device. In this sense, the spine display can function analogously to an ambient display. The contents of the spine display can depend on OS settings, application settings, current notifications, contemporaneous user interactions, combinations thereof, and so forth. Examples of these aspects of a spine display are described below with reference to Figs. 2-4.

Fig. 2 below illustrates a foldable electronic device including a spine display with which a user is currently interacting.

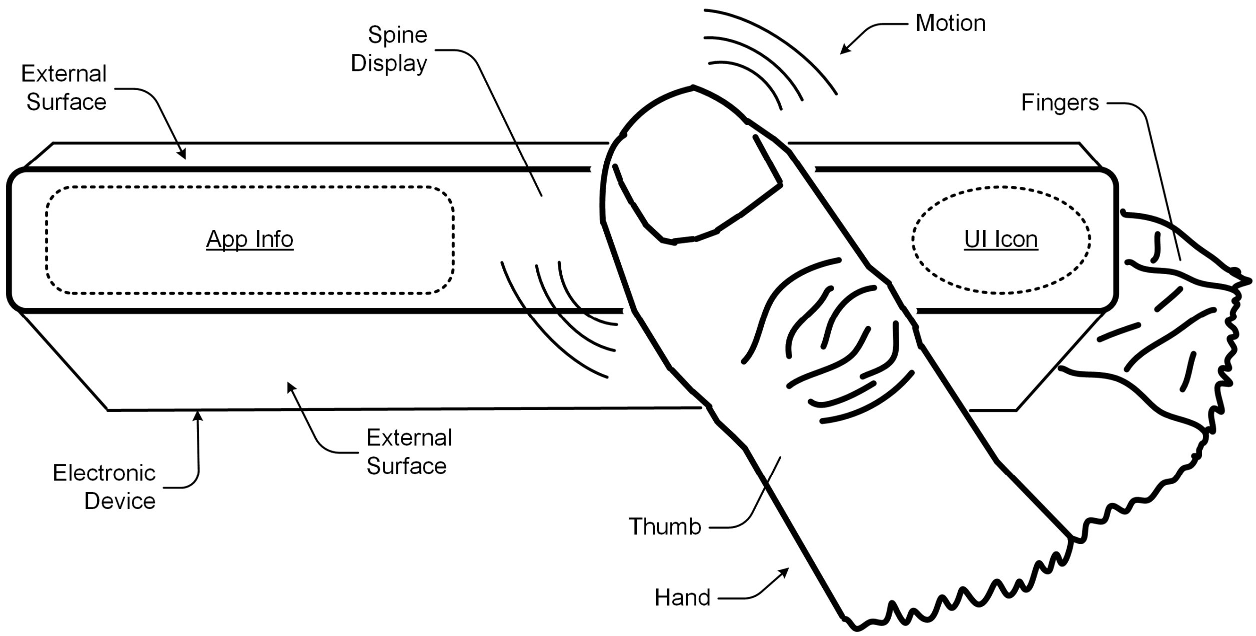

Fig. 2

As shown, the foldable electronic device is substantially closed such that a spine display feature is activated. The spine display currently presents application information ("App Info") and a user interface icon ("UI Icon"). The user is holding the device by cradling the inner section of the hinge part with four fingers of the user's hand. Although this may prevent the device from closing fully, the two portions, which are coupled to the hinge part, are sufficiently closed to activate the spine display. While activated, the user can interact with the spine display via touch with their thumb (as depicted) or a finger from another hand.

Physical touch interactions can include tapping, pressing a hot zone (e.g., a virtual button), long-pressing a spot of the display, swiping, touch-based gestures, scrolling, and so forth. The scrolling can be up and down or left and right (or both). The scrolling can be slow, fast, and with or without inertia or acceleration. As illustrated in Fig. 2, the thumb can engage in a motion against the spine display to cause the UI to change content that is being presented. For example, the thumb can tap the "UI Icon" to request additional details about the "App Info." Additionally or alternatively, the thumb can scroll downward—e.g., to see additional lines of text or more of a photo. Also, the thumb can swipe left or right to reach a different notification or content from another application. However, these UI interactions can be varied in different implementations to achieve other display changes.

In some implementations, the notifications that are presented on the spine display are tailored to reduce distractions or social interruptions. For example, certain applications may be permitted to present a spine display notification while other applications are excluded. The notifications that are permitted can be set to initially present an amount of information that is visible on the spine display without scrolling. Access to the spine display can be gated by the OS. Thus, privileged applications can be permitted to provide notifications on the spine display in a manner that is configurable by the user via one or more OS settings. Access to the spine display can further be dependent on an origin of a notification (e.g., whether a message is from a favored person), a time of day (e.g., whether a meeting is occurring as per calendar entries), whether the user is driving, and so forth. The user can be empowered to obtain more information through interactions, such as touch, gaze, or spatial gestures.

Figs. 3 and 4 below depict example screen shots of a presentation update for a spine display in a context with a transition between two different screen presentations.

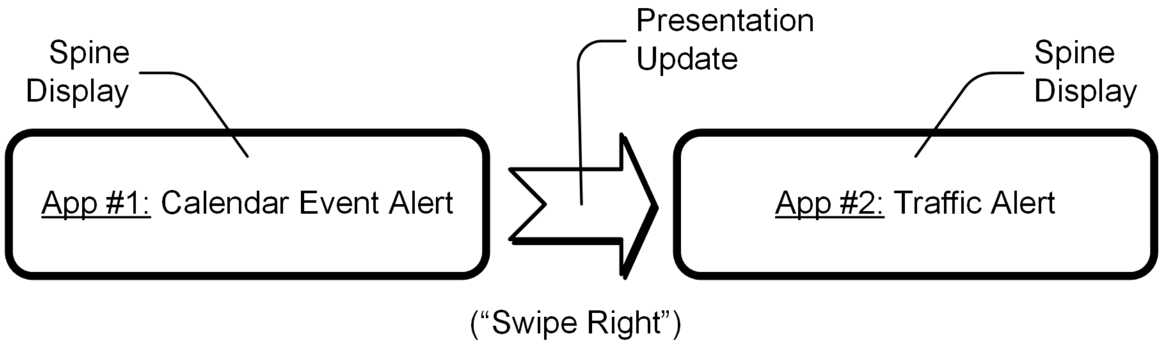

Fig. 3

Fig. 3 above illustrates a "swipe right" touch interaction that causes a presentation update of the spine display. In this example, a "Calendar Event Alert" (e.g., "Meeting with boss in 10 mins") from an Application #1 (e.g., a calendar application) is replaced by a "Traffic Alert" (e.g., "28 min delay on route home due to accident") by an Application #2 (e.g., a navigational or mapping application). Alternatively, a different UI interaction can cause the presentation update instead of a swiping motion. Further, operation of the OS can result in the replacement of alerts or a cycling of alerts.

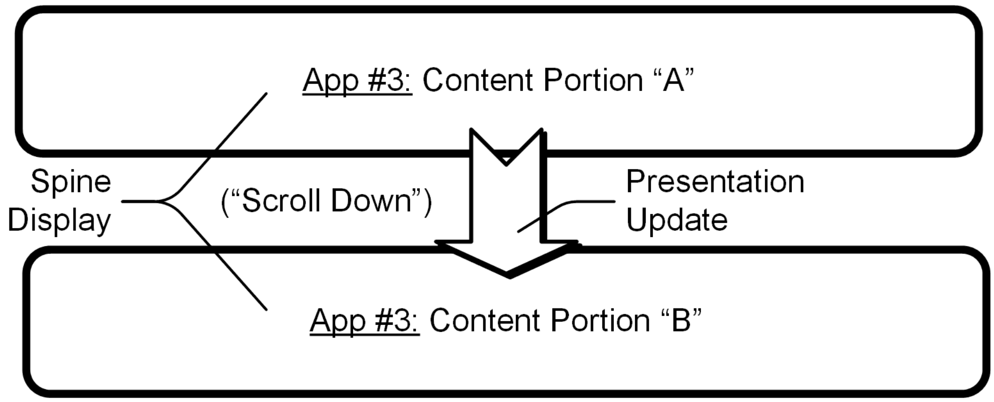

Fig. 4

Fig. 4 above illustrates a "scroll down" touch interaction that causes a presentation update on the spine display. In this example, a single Application #3 changes from providing portion "A" of an item of content (e.g., some text or a photo) to providing portion "B" of the item of content. Alternatively, a different UI interaction can cause the presentation update, such as eye tracking or spatial gesturing.