November 2022

Drag Gesture Interpretation via a Fly-Through Ring Menu

Holger Winnemoeller

Drag Gesture Interpretation via a Fly-Through Ring Menu

ABSTRACT

The drag operation, performed via a mouse, touchscreen, or other input device, is a common gesture to move data or objects within a user interface. For identical drag paths, there may be different user intents for the drag operation. For example, a file can either be copied or moved along a given drag path. This disclosure describes efficient and intuitive techniques for disambiguating the intent of a drag operation without excessive user interaction. Upon commencement of a drag operation on an object, a floating, ring-shaped menu, referred to as a fly-through menu (FTM), appears automatically around the cursor or point of contact of the finger with the touchscreen. The circumference of the ring menu is divided into arcs labeled with menu selections for intents associated with the drag gesture. A user can execute the desired action by tracing a trajectory through the corresponding arc of the ring menu.

KEYWORDS

- Fly-through menu (FTM)
- Floating menu
- Ring menu
- Pop-up menu
- Context-dependent menu
- Radial menu
- Drag operation
- Gesture-based UI
- Muscle memory

BACKGROUND

The drag operation is a widely used mouse or touchscreen gesture to move data or objects within a user interface (UI), to adjust system parameters via sliders, etc. For example, a user might drag a file from one folder to another, a graphical object from one side of the screen to the other, resize a 3D object by dragging one of its corners, etc.

The intent of drag operations can be varied, even for identical drag paths. For example, a file can be copied along a given drag path or moved along the same drag path. A graphical object might be cloned instead of copied. The precision of a drag gesture can be improved by snapping to specified markers or equal increments on a slider. In all of these cases, the same drag gesture can have multiple alternative interpretations that need disambiguation.

Disambiguating drag gestures is commonly done by selecting different tools from a toolbar (thus changing the internal state of the UI); by explicit selection of the desired intent from a menu; by holding down a modifier key during the drag operation; etc. Such techniques for disambiguating drag gestures don’t work well in constrained user interfaces, e.g., a smartphone screen or other small display. Any tool added to a toolbar takes away from screen space which is a scarce resource. Explicit menu interactions require additional steps that can slow down the user. Modifier keys generally require a dedicated keyboard which is often unavailable in the context of a mobile device.

DESCRIPTION

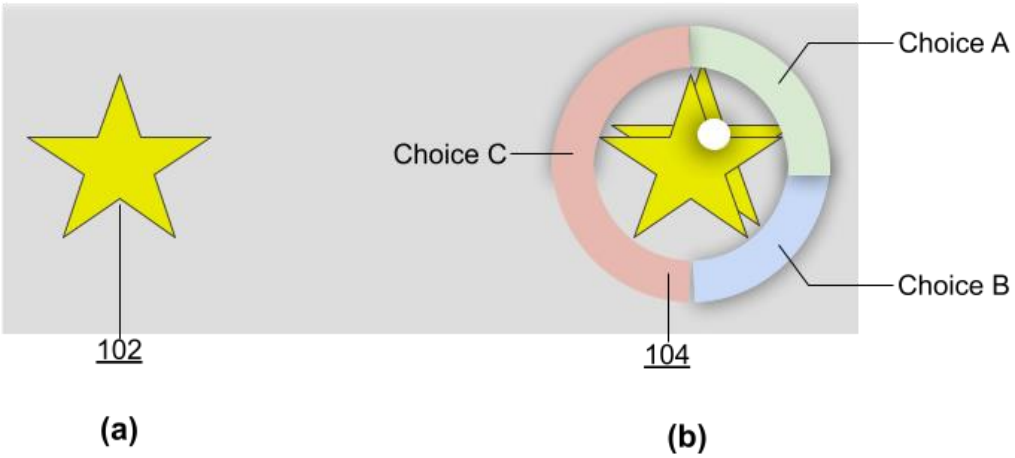


Fig. 1: Fly-through ring menu: (a) An object in a GUI; (b) A fly-through ring menu automatically appears upon selection of the object by the user

This disclosure describes efficient and intuitive techniques for disambiguating the intent of a drag operation without excessive user interaction. As illustrated in Fig. 1, upon the commencement of a drag operation on an object (102, Fig. 1a), a floating, ring-shaped menu (104, Fig. 1b), referred to as a fly-through menu (FTM), appears automatically without additional user interaction with a toolbar, a menu list, a keyboard, or other interface. The FTM appears around the cursor or around the point of contact (indicated by white circle in Fig. 1b) of the finger with the touchscreen. The circumference of the ring menu includes selections, e.g., copy, move, delete, clone, cancel, etc., associated with the drag gesture. For example, in Fig. 1(b), the green arc (Choice A) can represent copy, the blue arc (Choice B) can represent move, and the red arc (Choice C) can represent cancel.

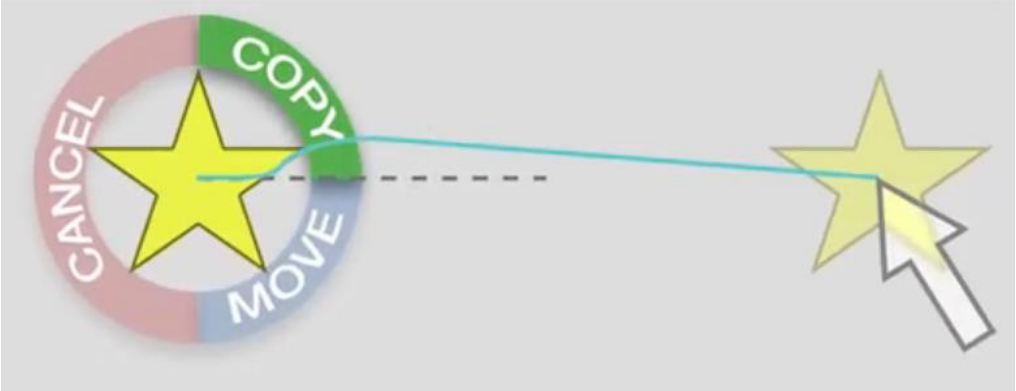


Fig. 2: Selection of a ring menu item

Selection of a ring menu item is achieved by subtly altering an idealized (straight-line) path between the start (source) and the end (target) of the drag operation. For example, as illustrated in Fig. 2, if the user's mouse (or finger) travels via the green arc, slightly away from the straight (dashed) line between source and target, the object is copied at the target location. If the user's finger (or mouse) travels via the blue arc (not shown), the object is moved from source to destination. If, after traveling through the green (copy) or blue (move) arcs, the user decides to cancel the drag operation, the user simply continues the mouse (or finger) path through the red (cancel) arc without releasing the mouse button (or without lifting the finger from the touchscreen).

Automatic alignment of the ring menu

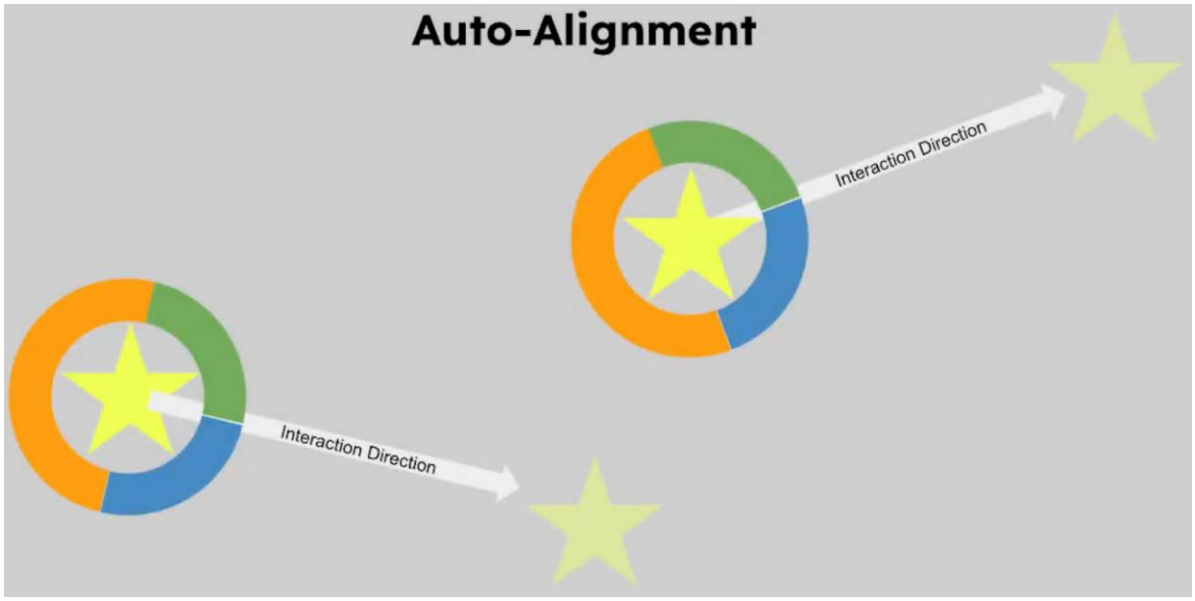


Fig. 3: Automatic alignment of the ring menu

Fig. 3 illustrates automatic alignment of the ring menu. The ring menu can automatically rotate such that certain menu item(s) are in the straight line between source and target. The menu can be designed such that popular menu items (e.g., copy, move, etc.) are closer to the straight line between source and target and therefore easier to select. The absence of automatic alignment, e.g., a design where the ring orientation is fixed, can cause certain menu selections to require a lengthy and inefficient trajectory.

Accessibility

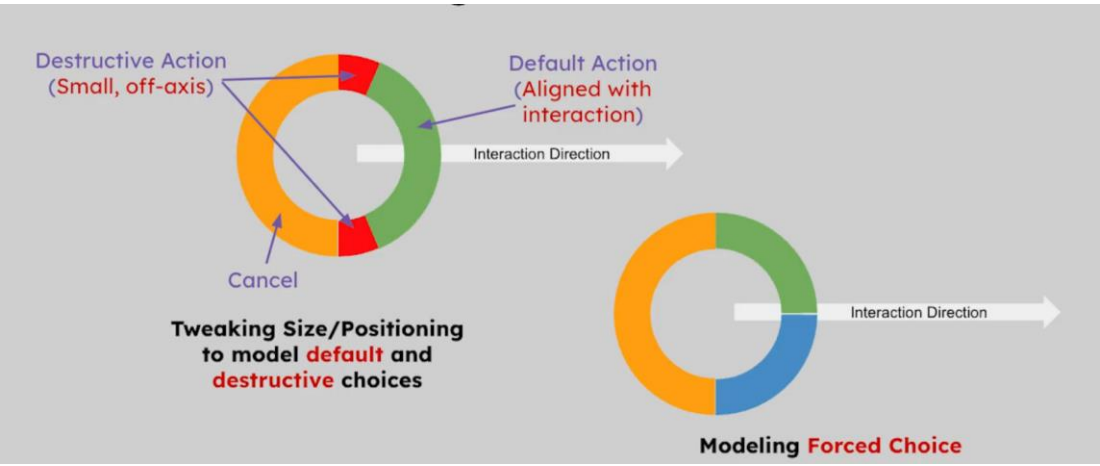
The automatic alignment feature of the FTM ring menu enables blind interaction, e.g., with practice, the user can use muscle memory to make a selection with only a cursory glance at the menu (or no glance at the menu at all). Menu selection that is based on muscle memory enables very fast user interactions. Also, leveraging muscle memory enables visually impaired users to rapidly make menu selections and interact efficiently with the user interface.

The target can be closer to the source than the radius of the ring menu

Fig. 4: The target can be closer to the source than the radius of the ring menu

Fig. 4 illustrates that a user can copy, move (or perform another operation) with source and target that are close to each other by starting at the source and tracing a tight curve through the selected menu item.

Modeling default behavior



(a) **(b)**

Fig. 5: Modeling default behavior

Illustrated in Fig. 5, the intuitive FTM layout enables the creation of menus with a variety of behaviors, such as default selection, forced choice selection, etc. For example, in Fig. 5(a), the ring menu automatically aligns such that a default menu item (green) is large and lies centrally along the straight-line path between the source and the target, e.g., it is along the interaction direction (or axis). Menu items that cause deletion can be made small, off-axis, and colored in a warning color (e.g., red) such that the user is made to exert some effort to select such items. The arc that selects cancel can be situated anti-axially. In Fig. 5(b), the ring menu automatically aligns such that the straight line between the source and the destination lies between two standard action menu items (green and blue). For example, the standard actions move and copy, which can be expected to occur with equal frequency, are equally weighted along the ring, emulating a forced choice behavior. The arc that selects cancel (orange) is situated anti-axially. In this manner, the size, the position, the automatic alignment mode, etc. of the ring menu can be tweaked by the designer to achieve desired default behaviors.

Design parameters

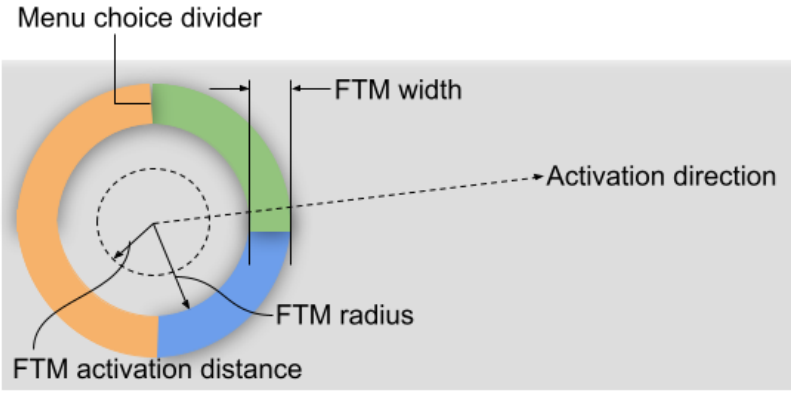


Fig. 6: Design parameters for the FTM ring menu

Fig. 6 illustrates that the UI designer can use a number of parameters to optimize the FTM ring menu, for example, FTM radius; FTM width; FTM activation distance (the distance at

which a selected object is moved in order to trigger the deployment of the FTM menu); menu choice dividers; etc. The activation direction, e.g., the straight line between the source and the target can be dynamically determined upon detecting the direction of movement intended by the user.

Flexibility in usage

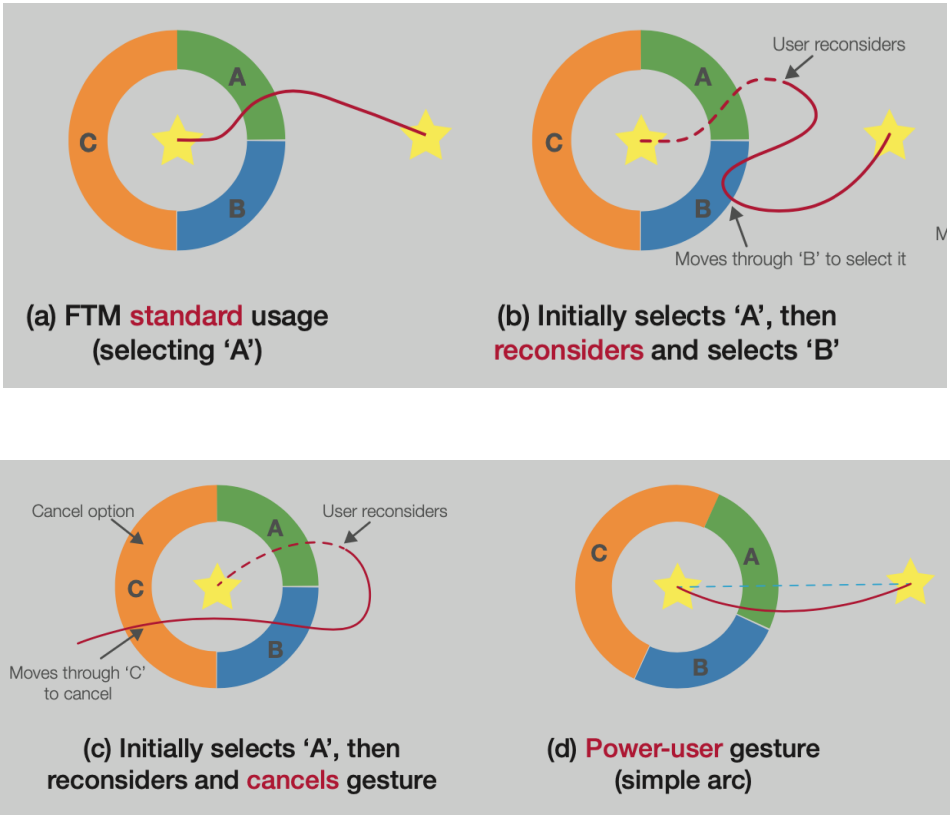


Fig. 7: Flexibility in usage

Fig. 7 illustrates flexibility in usage, e.g., the facility of changing the intent of the gesture midway through the gesture operation. Fig. 7(a) illustrates standard usage, e.g., where a user selects a menu item by traveling through the corresponding arc of the ring menu. In Fig. 7(b), the user initially selects a menu item A, then reconsiders and selects menu item B by simply adjusting the trajectory of the mouse (or finger) to travel through arc B. In Fig. 7(c), the user

initially selects menu item A, but decides to cancel (menu item C) the operation, which the user can do by making the trajectory of the mouse (or finger) to travel through arc C. Fig. 7(d) illustrates a power user operation, where a simple arc is used to effect the operation.

The described fly-through menu automatically deploys during a drag gesture and does not require additional user interactions with a toolbar, modifier key, or other interface. The FTM is applicable to small-screen devices like smartphones. It is also backwards compatible with desktops, laptops, tablets, or other large-screen devices that may or may not have a keyboard. When implemented on a desktop, the FTM can be an effective alternative to keyboard modifiers on menus, with the advantage that there is no need for the user to memorize a keyboard mapping.

The described fly-through menus enable users to perform reliable and intuitive menu selection with minimal training and without slowing down the user or breaking their workflow. The FTM can increase work efficiency and reduce user fatigue. It is also suitable for accessibility applications for the visually impaired.

CONCLUSION

This disclosure describes efficient and intuitive techniques for disambiguating the intent of a drag operation without excessive user interaction. Upon commencement of a drag operation on an object, a floating, ring-shaped menu, referred to as a fly-through menu (FTM), appears automatically around the cursor or point of contact of the finger with the touchscreen. The circumference of the ring menu is divided into arcs labeled with menu selections for intents associated with the drag gesture. A user can execute the desired action by tracing a trajectory through the corresponding arc of the ring menu.

REFERENCES

1. Damaceno, Rafael Jeferson Pezzuto, Juliana Cristina Braga, and Jesús Pascual Mena Chalco. "Mobile device accessibility for the visually impaired: problems mapping and empirical study of touch screen gestures." In *Proceedings of the 15th Brazilian Symposium on Human Factors in Computing Systems*, pp. 1-10. 2016.
2. Kane, Shaun K., Jacob O. Wobbrock, and Richard E. Ladner. "Usable gestures for blind people: understanding preference and performance." In *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems*, pp. 413-422. 2011.
3. "WinForms Radial Menu Control," https://www.syncfusion.com/winforms-ui-controls/radial-menu, accessed Oct 19, 2022.