

# ART019: A Time-Based Sketchbook Interface

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## ABSTRACT

Sketching has been regarded as a primary means of externalization for creative processes in the early stages of design. Existing sketchbook interfaces have primarily used two notions in their interaction design: layer-based or page-based. This paper presents a third approach, which focuses on the temporal aspect of drawing. We have developed ART019, a sketchbook interface based on a time-based representation for hand-drawn strokes, where free-hand drawing is recorded as a sequence of time-stamped strokes. While drawing in ART019, a user takes a snapshot of the drawing area, draws anew, or draws on top of one of the previously taken snapshots and takes another snapshot. ART019 records all the strokes with time-stamp information, including the duration and the speed of drawing. Each stroke has either an active or inactive state, where only active strokes are visible in the drawing area. A set of active strokes is stored as a snapshot. ART019 provides a timeline-based representation and a list of all the strokes to help a user make strokes active or inactive. By using these mechanisms in ART019, a user may re-experience, select, or compare different stages of sketching.

## Keywords

Time-based sketching interface, interaction design, timeline-based representation for stroke data, tool support for creative process

## 1. INTRODUCTION

The hand-drawn sketching process has been regarded as an essential ingredient of the early stages of a design process across different design domains [7]. Nevertheless, not much has been explored regarding how the use of computational mechanisms could go beyond that of paper and pencil [1][8].

There have been three approaches in designing computer support for sketching: by understanding informally hand-drawn diagrams to convert them into more formalized objects (such as VR Sketchpad [2], and Denim and SILK [5]), by using hand-drawn diagrams as indices for locating relevant information (such as Cocktail Napkin [3]), and by designing computational media for sketching in place of traditional sketchbooks or paper and pencil to enrich a user's sketching experience (such as Digital Sketchbook [4]).

Our research falls in the third category. Many of tools in this category use two conventional notions in their interaction design that have been practiced with traditional media: *layers* and *pages*. The notion of *layers* has been used in a number of current drawing systems. It is based on the conventional design practice of using tracing paper. Users compare alternative drawings by turning each layer on and off, and manage variations of drawing by combining

multiple layers or copying-and-pasting an object among several layers. The notion of *page* has also been widely used in computational tools to manage drawings. Some tools allow users to smoothly flip through pages or “dog-ear” pages to remember which pages have important drawings [4].

This paper presents a third approach, which focuses on the aspect of *time* in a sketching process. Sketching has two aspects: as a representation, and as a process. On the one hand, sketches are objects, which are hand-drawn diagrams on a sheet of paper. On the other hand, sketching is a sequence of actions, which results in a drawing experience in which a designer holds and moves a pen (or a pencil) against a sheet of paper. During the process, a user engages in a type of “conversation” with the emerging representation [9]. Our approach in designing tools for supporting sketching is guided by focusing on such a sketching process. In particular, designers engaged in a hermeneutic circle [10] through sketching should be able to easily interpret situations, and project meanings through drawing while going back and forth between the stages as new meanings emerge, and his/her interpretations change [8].

This paper presents ART019, a sketchbook interface based on a time-based representation for hand-drawn strokes, where free-hand drawing is recorded as a sequence of time-stamped strokes. ART019 allows a user to go back and forth to any point in the previous stages of his/her drawing, and to continue the drawing at any point through a time-based representation of hand-drawing processes. The user may compare different stages of drawings and explore the drawing experience using the ART019 mechanism.

## 2. ART019: A TIME-BASED INTERFACE FOR SKETCHING

ART019 is a sketchbook interface based on a time-based representation for hand-drawn strokes, where free-hand drawing is recorded as a sequence of time-stamped strokes. Figure 1 illustrates ART019. ART019 consists of four components: DrawCanvas, StrokeTimeline, StrokeList, and SnapshotShelf.

A user draws sketches in DrawCanvas. The user may take a snapshot of DrawCanvas by clicking on the SnapshotButton at any point of time in drawing. A thumbnail image of the snapshot is then displayed in SnapshotShelf (see the left column in Figure 1). Clicking on the *renew* button in SnapshotShelf allows a user to start drawing anew.

Snapshots are like bookmarks for sketching stages in DrawCanvas. Clicking on a snapshot in SnapshotShelf allows the user to draw on top of the snapshot drawing, and the user may then take another snapshot.

ART019 records all the strokes with time-stamp information, including the duration and the speed of drawing. StrokeTimeline and StrokeList provide two types of representations for the stroke information (see Figure 2).

StrokeList shows a list of information on each stroke, consisting of the starting and ending time of the stroke being drawn, the duration of the time of drawing the stroke, the length of the stroke, the speed of drawing the stroke, a thumbnail image of the stroke, and the status of whether the stroke is *active* or *inactive* (see below for the description of active strokes).

StrokeTimeline presents a sequence of a temporal representation of each stroke. The temporal representation of a stroke in ART019 consists of two dimensions. The horizontal dimension corresponds to that of DrawCanvas. The vertical dimension corresponds to the time when each point on the stroke is drawn.

Figure 2 illustrates the mechanism. In figure 2, four strokes have been drawn, a circle (s1), a triangle (s2), and an X-shape (s3 and s4) in the order. When the user draws s1 in DrawCanvas, the temporal representation of s1 appears in StrokeTimeline. When the user draws s2 in DrawCanvas, the temporal representation of s2 is added in StrokeTimeline. The temporal representations of s3 and s4 appear when the user draws s3, then s4. Note that the

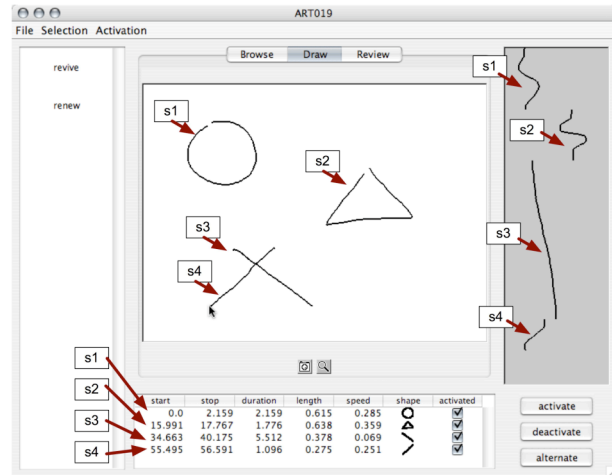


Figure 2: StrokeList and StrokeTimeline of ART019

StrokeList allows a user to examine each stroke. StrokeTimeline always shows the entire history of the strokes drawn.

In ART019, each stroke has either an *active* or *inactive* state, where only *active* strokes are visible in DrawCanvas. Figure 3(a) shows the same drawing stage as Figure 2 except that two strokes, s3 and s4, are made inactive. Inactive strokes are displayed in white in StrokeTimeline, and their “activated” checkmarks are turned off in StrokeList. A stroke is always active when initially drawn in DrawCanvas.

ART019 uses this mechanism to store snapshots. That is, a snapshot in ART019 is stored as a set of active strokes. Selecting a snapshot will bring back the state of the active strokes at a specific time. When a user starts drawing anew by selecting the “renew” button in SnapshotShelf, all the existing strokes are made inactive resulting in an empty canvas. Selecting the “revive” button makes all the existing strokes active resulting in displaying all the existing strokes in DrawCanvas.

Instead of deleting a stroke from the sketch, a user can make a stroke inactive; inactive strokes are drawn in white and therefore become invisible in DrawCanvas, which is also white (the strokes remain visible in StrokeTimeline, however, which is gray).

StrokeList and StrokeTimeline help a user make strokes active or inactive. The user may select a region within StrokeTimeline by dragging a stylus pen (or a mouse), resulting in the *selection* of temporary sequential strokes; selected strokes are then visually emphasized in DrawCanvas (Figure 3(b)). Corresponding strokes are also emphasized with a different background color in StrokeList. The user may select either active or inactive strokes, or both.

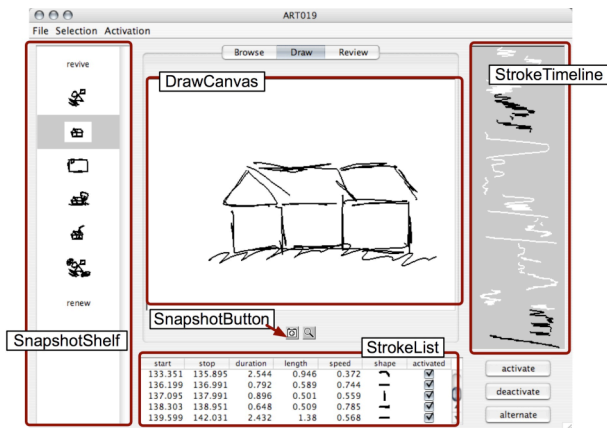


Figure 1: The ART019 System

temporal representation of s3 is much longer than that of s4 in StrokeTimeline because s3 was drawn much slower (i.e., by taking a longer time) than s4.

As a user draws a stroke in DrawCanvas, the temporal representation of the stroke appears in StrokeTimeline by shrinking the vertical length so that the entire sequence of strokes is always visible. As soon as the user finishes drawing the stroke, the information about the stroke is appended at the bottom of StrokeList. All the strokes drawn in DrawCanvas become persistent and remain accessible in StrokeList and StrokeTimeline.

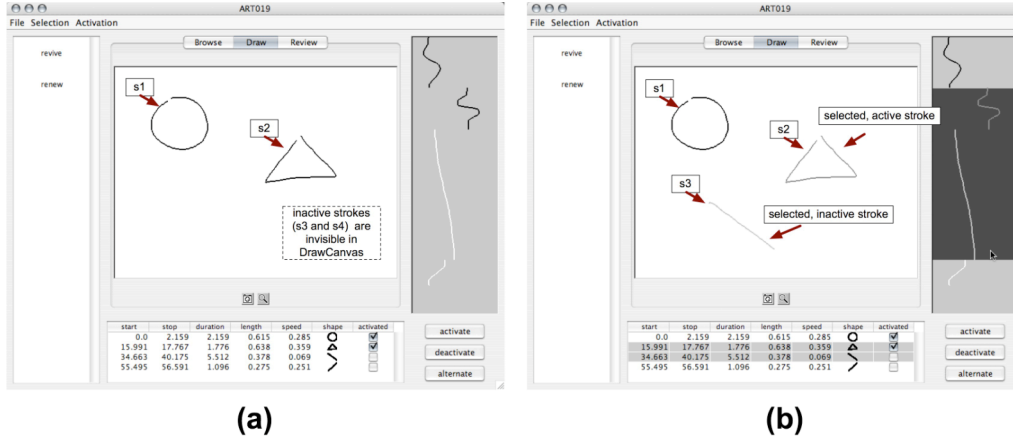


Figure 3: Stroke status in ART019: (a) active and inactive strokes; (b) selected strokes

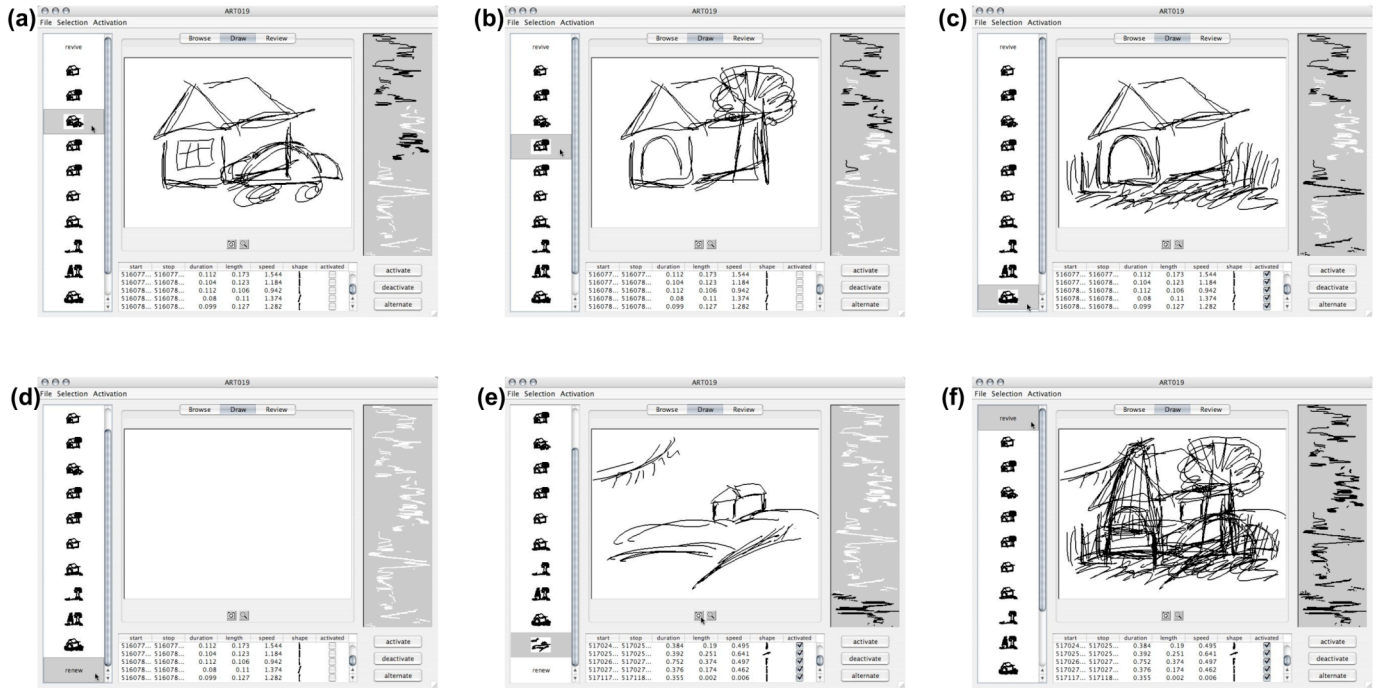


Figure 4: Drawing sketches using ART019

In Figure 3(b), two strokes, s2 and s3 are selected. S2 and s3 are both visually emphasized in DrawCanvas but with different colors because s2 is currently active and s3 is currently inactive.

The user may make the selected strokes active or inactive by using the buttons provided in the bottom-right corner of ART019. The user may select either active or inactive strokes, and alternate the activation status.

By using these mechanisms in ART019, a user may re-experience, select, or compare different stages of sketching. Figure 4 illustrates a series of sketches using ART019. Different drawings can be kept in the SnapshotShelf. The user may go back to the previous drawing, and revise a part of the drawing by making some strokes inactive and keep drawing on it. ART019 uses the temporal aspect of drawing and the notion of active and inactive

strokes to allow a user to keep different drawings, create variations of the drawings, and explore alternative drawings.

### 3. DISCUSSION

A user of ART019 can re-experience the order of drawing, select certain strokes through the time-scale interface to create a snapshot, and produce different versions of drawings for comparison without losing any historical data of drawing. We have argued that the three interactions, re-experience, selection, and comparison, are fundamental in supporting a sketching process [8]. This paper has demonstrated that ART019, a time-based sketching book interface, allows a user to engage in the three interactions.

Despite the prevalence of pen-based interfaces and touch-screen computers, many practitioners still prefer paper and pencil for

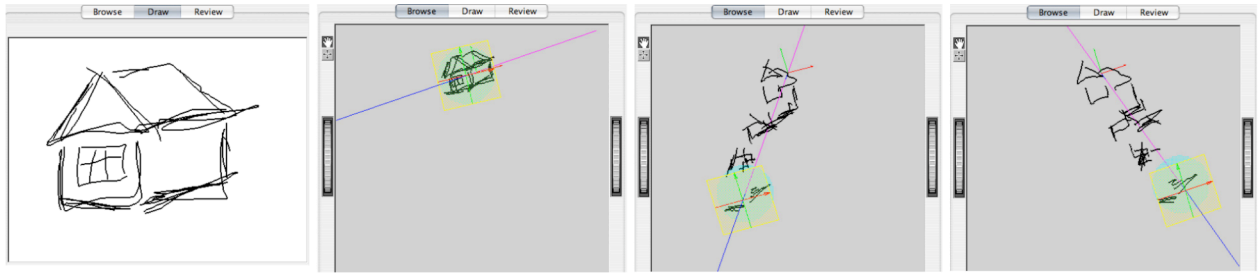


Figure 5: The *draw* and *browse* modes in ART019

sketching [4]. The nature of a designer's sketching process may sometimes not be in concordance with high functionality provided by existing drawing tools. For instance, some designers may never want to delete what has been drawn. Others may iterate drawing almost identical objects many times, and still other designers may never want their drawn objects moved around within a page because they find the layout of objects within a page to be very important.

Our approach is centered around such concerns, and the interaction design of ART019 tries to avoid unnecessary functionality and provides a "minimum" intrusion in some sense to ensure a smooth and natural drawing experience for users. We focus on the notion of *time* and propose a time-based approach for supporting users interacting with sketched representations.

ART019 consists of three modes: *browse*, *draw*, and *review*. What has been described above is about the *draw* mode. The *browse* mode has been built to allow a user to interact with the time-based representation of the sketched strokes in a 3D space (see Figure 5). The *review* mode would allow a user to "replay" stroke-drawing processes of the user. We will further explore how one should interact with the representations in this review mode in future work.

#### 4. ACKNOWLEDGMENTS

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