

CalPal: An Intelligent Multimodal Digital Wall Calendar

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Abstract

Mobile calendaring applications have become indispensable tools for organizing daily life, yet they lack the tactile and personalized qualities of traditional paper calendars, which have been shown to enhance engagement and goal commitment. While digital wall planners exist, they fail to replicate the rich, interactive experience of their physical counterparts. Leveraging recent advancements in generative artificial intelligence, we present CalPal, an intelligent multimodal digital wall calendar designed to merge the strengths of digital and paper-based planning. CalPal supports pen-based input for event creation in the user's own handwriting, gesture-based navigation for seamless interaction, and synchronization with mobile platforms. Additionally, it uses a stable diffusion model to create dynamic, visually engaging themes based on the calendar's events, aiming to enhance the reflective and aesthetic qualities of the calendaring experience. We outline the design and implementation of CalPal, illustrate its functionality through an example user scenario, and discuss future work to evaluate the effectiveness of the platform in harmonizing the strengths of traditional and digital calendaring practices.

Keywords

Handwriting recognition, Gesture, Stable Diffusion, Calendar

1. Introduction

In recent years, traditional scheduling tools such as wall calendars and paper planners have largely been supplanted by mobile calendaring applications like Google Calendar and iCal. According to one survey, over 70% of respondents identified that they rely primarily on digital calendars to organize their lives, favoring them over paper-based alternatives [1]. While these mobile platforms offer unmatched convenience, they lack some of the unique advantages of physical mediums. For instance, the tactile experience of writing on a paper calendar provides a more natural and intuitive interaction, allowing for personalized annotations that go beyond the constraints of a standard keyboard. Although digital wall-based planners are commercially available [2, 3], they fail to replicate the type of engagement possible with paper calendars,

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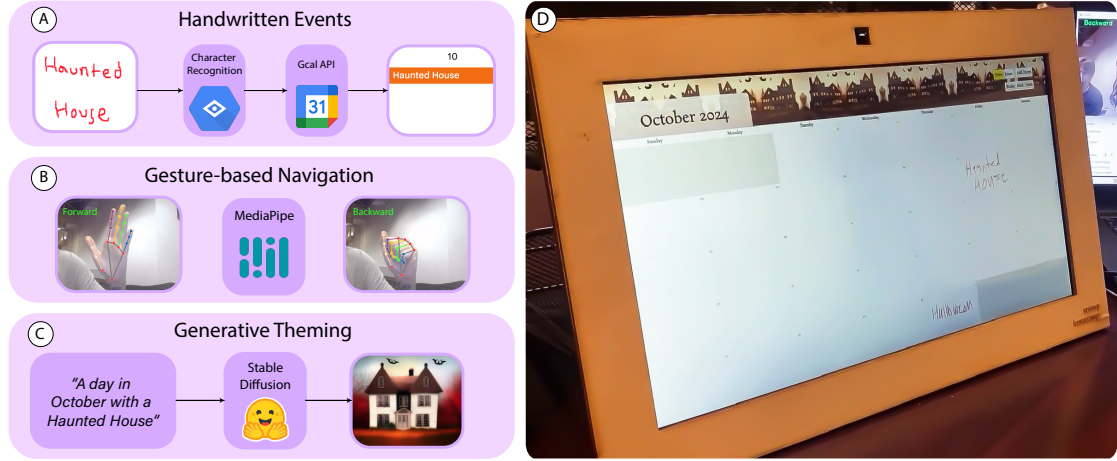


Figure 1: CalPal features (A) handwritten event inputs (B) gesture-based calendar navigation and (C) generative theming based on events for the month. We demo the system with open source hardware and software (D).

which have been shown to encourage greater commitment to long-term goals than their digital counterparts [4].

Amid the growing prominence of digital scheduling and planning solutions, researchers have begun exploring generative artificial intelligence (gen AI) models as tools for fostering reflection, planning, and productivity. For example, Pataranutaporn et al. [5] developed a platform based on Large Language Models (LLMs) that enables users to converse with their future selves, enhancing future self-continuity and well-being. Calendars, as a rich source of natural language, offer a promising interface with these models. While prior work has explored integrating digital calendar data with LLMs for stress management interventions [6], no research has investigated leveraging generative models to alter the visual calendar design, a defining aspect of the paper calendaring experience.

In light of these observations, we prototyped “CalPal”, an intelligent multimodal digital wall calendar. CalPal combines the accessibility of digital calendars, the materiality of traditional calendaring practices, and the generative creativity of stable diffusion models to provide a dynamic reflective interface for event scheduling. It features pen-based event tracking and display, synchronization with mobile calendar platforms, gesture-based navigation, and generative theming based on added events. We detail its implementation, showcase the system’s dynamic functionalities through an example user scenario, and reflect on future evaluations which may highlight the benefits of embodying generative intelligence into digital electronic artifacts which are more evocative of their analog counterparts.

2. System Design and Implementation

We began reimagining the paper wall calendar as a digital platform by identifying three core design objectives: 1) to replicate the tactile and visual familiarity of a paper wall calendar while incorporating the scheduling convenience of mobile calendars, 2) to integrate a generative

model for creating playful and reflective calendar themes, and 3) to ensure the system is open-source and easily replicable, using accessible hardware and software to encourage further experimentation and adaptation.

To realize these design goals, we prototyped CalPal as a stateful web application with a ReactJS frontend and a Python Flask backend. The system runs on a laptop connected to a 15.6-inch Waveshare Capacitive Touch LCD screen (\$156.99) via HDMI and USB. This configuration enables gesture-based interactions using the laptop’s built-in camera and supports pen-based inputs on the touchscreen. The platform is fully open-source, with detailed setup instructions available via GitHub ¹ and a video demo of the system capabilities available online ².

2.1. Handwritten Events

The touch display is used to simulate the experience of writing on a physical calendar. In order to write events, the user selects the “Draw” button and begins drawing on the screen using a standard capacitive touchscreen stylus. The touch inputs are processed by the browser’s native touch event callback functions and used to update an HTML <canvas> element for real-time display. Should the user not like what they have written, they can select the “Erase” button which will automatically erase what they had last written.

In order to add events to the calendar the user must write in the event date box that the event should be scheduled for. By tapping the “Add Event” button the most recently written phrase is segmented using the Google Cloud Vision Optical Character Recognition API [7], and synced to the Calendar using the Google Calendar API (Figure 1A). Should the event writing be unrecognizable by Google Cloud Vision, the user will be notified with an error asking them to try again. The system supports the addition of all-day events as well as timed events. In order to remove events from the calendar after they have been added, the user can select “Erase”, then tap anywhere on the text of the event they would like to remove, and the event will be removed. In “Erase” mode the user is unable to draw on the calendar.

The user is additionally able to flip backwards and forwards through the calendar pages by tapping “Back” and “Next” respectively. Tapping on the “Today” button resets the calendar view back to the current month.

2.2. Gesture-based Navigation

To complement button-based navigation, we support gestures for flipping calendar pages, recreating the experience of flipping through a paper calendar. Using a locally deployed MediaPipe Hand Landmarker model [8], we process real-time video frames to classify hand poses into the starting or ending poses of one of two gestures—flip forward or flip backward—or no gesture. If a starting pose for a gesture is detected, users have five seconds to complete the corresponding ending pose before the recognizer resets. To flip forward, users hold their hand upright in a closed fist, then open it. To flip backward, users hold their hand upright with the pointer finger extended, then close their fist (Figure 1B).

¹CalPal Github Repository

²CalPal Demo

Gesture detection relies on analyzing hand orientation and finger positions. We use the slope of the line between the wrist and the metacarpophalangeal (MCP) joint of the middle finger to determine whether the hand is upright as the first criteria for gesture detection. If the hand is upright, we determine if the hand is closed or open using the finger positions. For a closed hand, we assume the y coordinate of the distal interphalangeal (DIP) joint is smaller than that of the corresponding MCP joint for each finger. For an open hand, we assume the distance from the wrist to the DIP joint exceeds that to the corresponding proximal interphalangeal (PIP) joint for each finger.

Starting and ending poses are detected for each gesture using similar logic. For example, the ending pose for the flip forward gesture is detected when all fingers are open, while the ending pose for the flip backward gesture is detected when the hand is fully closed.

2.3. Generative Theming

Whenever an event is added to or removed from the calendar, a new theme banner is generated (Figure 1C). This process involves querying an open-source diffusion-based text-to-image generation model inference API [9] using the events for the current month. The default prompt for the model is:

"A day in <month> with <events> in the style of a painting."

Here, <month> represents the month of the updated event, and <events> is a comma-separated list of all events for that month, as extracted using the Google Cloud Vision handwriting text recognition API.

The generated image is then resized to match the aspect ratio of the calendar theme banner. To ensure continuity, the image is mirrored and concatenated with itself, then tiled horizontally to cover the entire banner space.

3. Hypothetical Example: Anna's February

Anna starts up her CalPal and flips to February. The page is devoid of events and the generative theming displays a barren, wintry landscape— a visual reminder of the season's quiet solitude (Fig. 2A). The scene sparks a realization: she could plan activities to brighten her month. Inspired, Anna adds two events to her calendar: attending an ice sculpture festival on the 7th (Fig. 2B) and planning a Valentine's Day date night with her partner on the 14th (Fig. 2C).

As she inputs the events, the generative theme evolves, transforming into an image of a couple admiring an ice sculpture together. This subtle change fills Anna with gratitude for her partner and the opportunities to share meaningful experiences.

A few days later, Anna learns that her best friend John has accepted a new job out of state and will be moving at the end of the month. Saddened but determined to make the most of their remaining time, she adds John's farewell party on the 19th to her calendar. The generative theme shifts again—the couple disappears, leaving the icy landscape tinged with a sense of emptiness (Fig. 2D). This change stirs feelings of longing and prompts Anna to reach out to

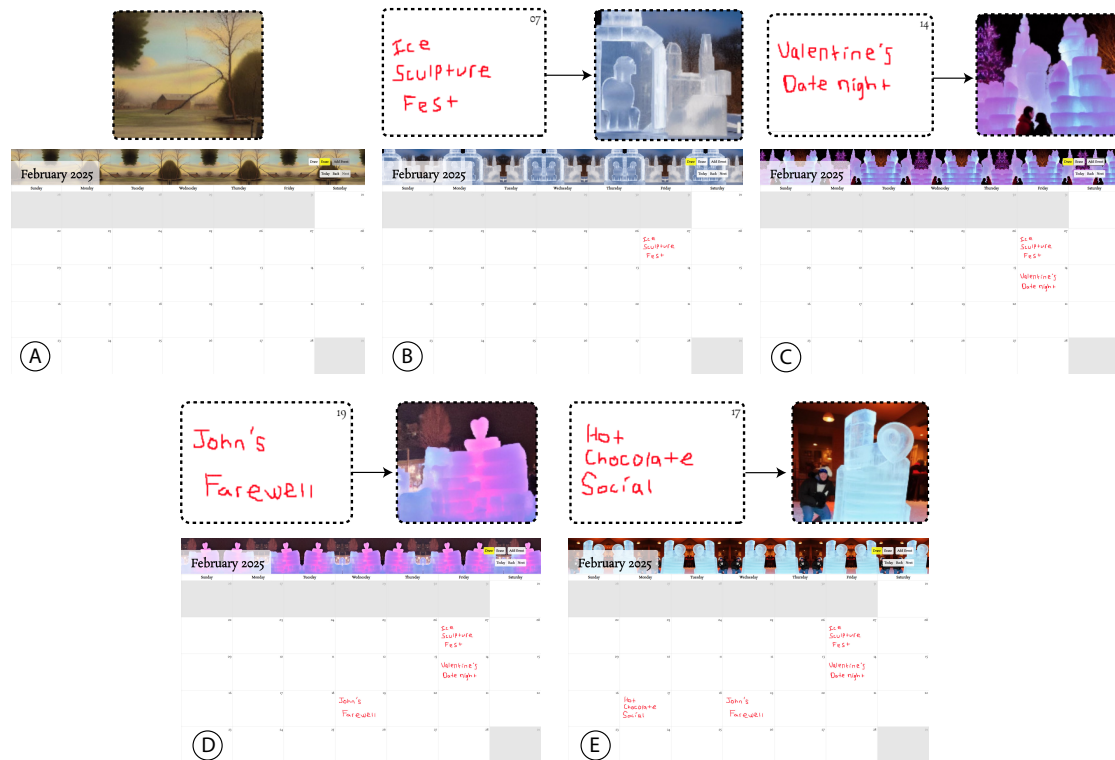


Figure 2: A-E) Progression of generative calendar theming as new events are added for the month of February. Calendar images generated by AI tool Hugging Face Stable Diffusion API.

John immediately. Together, they plan a cozy hot chocolate social before his departure, ensuring they create one last cherished memory (Fig. 2E).

Through its dynamic visuals, CalPal not only helps Anna stay organized but also deepens her emotional engagement with her plans, turning her calendar into a source of inspiration, connection, and reflection.

4. Conclusion and Future Work

We have presented the design and implementation of CalPal, a physically embodied digital wall calendar that supports handwritten event input, gesture-based navigation, and generative theming. Future work can leverage CalPal in longitudinal studies to explore research questions such as:

How effective is generative AI in visualizing goals, and does this assist humans in achieving them? Research suggests that positive visualization can enhance individual success and decision-making [10, 11]. CalPal offers an opportunity to evaluate the capability of generative AI in facilitating this visualization process. For instance, a study could investigate whether users engaging with AI-generated themes are more likely to define specific, measurable

objectives compared to those using non-generative designs or even to those using static designs such as those in traditional calendars.

Does integrating AI with physical artifacts increase their perceived value? A study by Atasoy and Morewedge [12] highlighted that physical goods are often valued more than digital ones due to their greater capacity to garner an association with the self. CalPal can be used to explore whether generative intelligence enhances this self-connection with physical artifacts. This could be assessed through measures of sustained user engagement, emotional attachment, and willingness to pay for different calendar formats (e.g., mobile apps, paper calendars, CalPal without generative AI, and CalPal with generative AI).

How can generative AI augment or enhance memory? Calendars often serve as time capsules, documenting past events while supporting future planning. CalPal could investigate the potential of generative AI to improve memory recall and foster meaningful connections. For example, studies might evaluate whether AI-generated themes make it easier for users to remember events or tasks compared to traditional calendars. Additionally, CalPal could explore cognitive benefits, such as using optimistic prompts to generate images from difficult or sad events, helping users reinterpret hardships in a more positive light.

By providing implementation details and making the platform open-source, we aim for CalPal to serve as an accessible tool for exploring these research questions and beyond. Ultimately, CalPal seeks to inspire further innovation at the intersection of generative AI devices, tangible interaction, and personal productivity, fostering new insights into how such devices may enrich our daily lives.

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