

PalPalette: Sharing Photo-Extracted Color Palettes with a Pal for Ambient Communication

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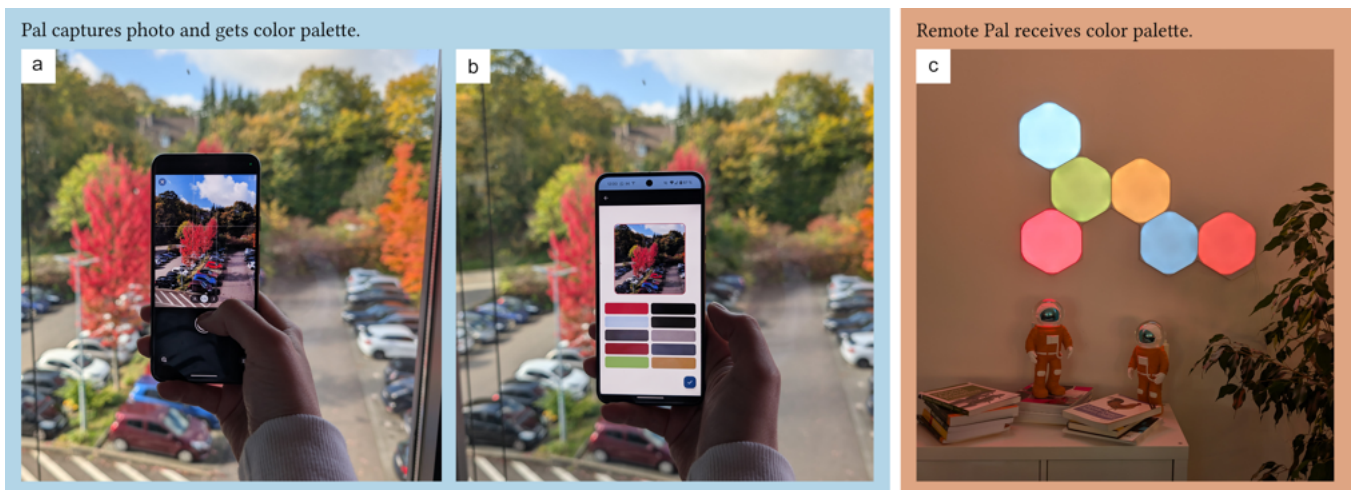


Figure 1: *PalPalette* prototype used to capture a photo (a), extract a color palette (b), and transfer it to the modular light panels of a remote friend (c). In this example, the pal transmitted a *sunny autumn* color palette to the remote pal.

ABSTRACT

Maintaining connection and communication across long distances can be challenging for friends. Traditional methods such as texting or video calls may sometimes feel too direct or intrusive. To offer a more subtle approach, this paper introduces *PalPalette*, a prototype system aiming to subtly share personal moments and foster a sense of connection despite physical separation. The prototype consists of illuminated modular light panels, a microcontroller, a gateway service, and a smartphone app. It works by extracting a color palette from photos taken via the smartphone app, transmitting it to friends through the service, and adjusting the lighting on the panels via the microcontroller, to reflect the friend's environment. The results of a preliminary usability study with 14 participants indicate that the *PalPalette* prototype demonstrates *good* usability (System Usability

Scale Score = 72.86), and open feedback suggests its potential to provide an effortless and lightweight medium for communication.

CCS CONCEPTS

• **Human-centered computing** → **Ubiquitous and mobile devices**.

KEYWORDS

modular light panels, long-distance friendships, ambient communication, color-based messaging

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1 INTRODUCTION AND RELATED WORK

Many people seek ways to maintain meaningful personal connections despite physical separation. While communication through

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text messages, calls, or video chats offers interaction, these methods are often obtrusive and fail to capture the depth of shared experiences. To foster personal connections across distance, various authors have explored ambient communication. Ambient systems can convey a sense of presence through signaling of physical actions [3, 20], minimal exchanges [15], or the translation of mood and presence into visible light patterns [9]. Over and above specific actions, such systems can deliver unobtrusive contextual information, thereby offering a method of maintaining low-effort awareness between users [14] and encourage social interaction [23]. Additionally, authors have explored methods for connecting family, friends, or partners over distance using light [6, 10, 16], photos [4, 7, 8], or location information [2, 13], as well as frameworks or strategies on how to maintain closeness in remote friendships or relationships [12, 17–19].

Unlike prior systems that focus on either motion, symbols, or pre-set patterns, *PalPalette* translates real-world visual experiences – such as photos – into light-based communication. It provides an abstract, minimal system that leverages the emotional and aesthetic qualities of light and color. Inspired by Media Richness Theory (MRT) [21] and the concept of media adequacy, we designed *PalPalette* by balancing the advantages and disadvantages of rich media, which can transmit too many cues and consequently overwhelm the user, and lean media, which might be ineffective in conveying subtle nuances and the equivocality inherent to meaningful communication. *PalPalette* transforms everyday visual experiences, such as the colors captured in a photo, into colors displayed on modular light panels that are shared between distant friends homes. This aims to create an ambient, continuous awareness of a communicator’s presence, enabling a lightweight and engaging form of communication. Drawing on Harrison and Dourish’s (1996) discussion of place and space, our prototype integrates social interaction into the living environment, enabling distant pals to remain connected as part of their everyday lives [11]. A preliminary evaluation based on the System Usability Scale (SUS) indicates that *PalPalette* offers an effective communication pattern that avoids overburdening users and allows for a seamless integration into daily life.

2 CONCEPT

PalPalette is designed to foster emotional connection between long-distance friends by using ambient light as a subtle medium for non-verbal communication. A prototype was developed that captures photos of a user’s environment through a smartphone app, extracts the dominant colors from the photos, and uses them to illuminate modular light panels installed at one or multiple long-distance friend’s homes. This allows the friends to share abstract visual cues about their surroundings without needing to communicate explicitly. The main goal of *PalPalette* is to create a seamless, unobtrusive way to maintain a sense of shared presence over distance, using light colors as a subtle form of interaction. By enabling friends to send abstract, visual “messages”, *PalPalette* intends to foster communication without requiring meaningful information to be exchanged. It may be used as an icebreaker for starting conversations through other communication channels, and promote feelings of presence by reminding users of their friends. This method of

ambient communication should encourage users to maintain connection effortlessly and effectively.

3 PALPALETTE PROTOTYPE AND TECHNICAL DETAILS

The *PalPalette* prototype consists of three interconnected components for each user: Modular light panels (*Nanoleaf*’s¹ Hexagon Shapes), an ESP8266 microcontroller, that communicates with the *Nanoleaf* API, and the *PalPalette* app. A backend service manages communication between the microcontrollers and the app. It provides a REST API that connects the *PalPalette* app to the microcontroller at each friend’s location.

The controllers regularly post their data to the backend service, while the app retrieves color palettes with vibrant and most populated colors generated by the Android Palette API² and sends these back to the service. Upon receiving a message from the app, the backend processes the data and forwards it to an MQTT broker, using the unique identifier to route the message to the appropriate recipient. By processing messages in the backend instead of handling it directly through the app, the system achieves greater flexibility and scalability, reducing the need for user intervention.

4 PRELIMINARY USER STUDY

For an initial evaluation, a preliminary quantitative user study was conducted using the System Usability Scale [5]. After a brief introduction about the functionality and purpose of the first prototype of *PalPalette* (Fig. 1), 15 participants ($M = 13$, $F = 2$) were able to exploratively test it. Due to omitted responses, incomplete data sets were eliminated, resulting in a total of 14 questionnaires to be evaluated. The resulting SUS-score is $\mu = 72.86$ points ($\sigma = 27.454$), which is considered *good* usability.

In addition to the SUS questionnaire, qualitative data were collected through free text. The overall concept of using ambient light for non-verbal communication was found to be interesting, with participants appreciating its emotional and visual appeal. However, two participants questioned the added value of *PalPalette* compared to conventional communication apps, and expressed skepticism about its effectiveness in maintaining emotional connection. Several suggestions were raised regarding customization and interactivity. Four participants expressed the wish to choose or adjust specific colors from the palettes to better represent their environment. Two participants suggested integrating gamification elements, such as touch-based light panels to play games together, while another two participants suggested expanding *PalPalette* by linking it with other apps, such as messengers, to facilitate follow-up communication. A more sophisticated and customizable notification system was desired by three participants, including customizable message alerts. Lastly, two participants wished for the ability to revisit previously sent photos.

¹Official website: <https://nanoleaf.me/>

²Documentation: <https://developer.android.com/develop/ui/views/graphics/palette-colors>

5 CONCLUSION AND FUTURE WORK

This work aimed at developing a subtle method for sharing context information and fostering a sense of connection between long-distance friends. To achieve this, a prototype called *PalPalette* was created. The system generates color palettes of photos captured via a smartphone app, and transmits them to long-distance friends through a service. Microcontrollers then adjust the lighting on modular light panels, reflecting the colors of the friend's surroundings. The results of a preliminary user study based on the System Usability Scale (SUS) indicate that the *PalPalette* prototype provides a good usability. The qualitative feedback indicates that *PalPalette* has potential as a non-verbal communication tool, but also highlights important areas for improvement, such as customization options for adjusting color palettes, and enhancing interactivity. Further technical improvements include adding delivery confirmation features, or integrating dynamic visuals, and animations. To fully assess the system's potential for enhancing long-distance communication, comprehensive studies will be conducted that explore social connectedness [22] or closeness [1] in long-term use. These will help to contrast *PalPalette*'s impact on connections and engagement to communication methods with comparable media richness.

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