Clo(o)k: A Clock That Looks

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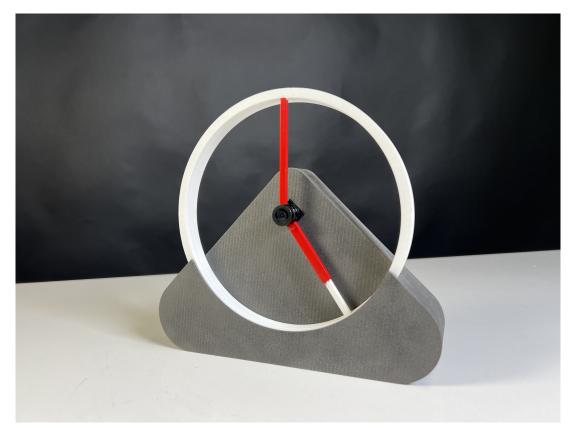


Figure 1: The Clo(o)k system. zhuoyuelyu.com/clook

ABSTRACT

What if a clock could do more than just tell time - what if it could actually see? This paper delves into the conceptualization, design, and construction of a timepiece with visual perception capabilities, featuring three applications that expand the possibilities of humantime interaction. Insights from an Open House showcase are also shared, highlighting the unique user experiences of this device.

CCS CONCEPTS

• Human-centered computing \rightarrow Interaction devices.

KEYWORDS

clock, time, tangible, telepresence

1 INTRODUCTION

Time is a fascinating concept, encompassing both objective and subjective dimensions. On one hand, it can be precisely measured and represented through the steady, periodic movement of a clock's hands. On the other hand, time can feel fluid and elusive, easily slipping away unnoticed as we become engrossed in our tasks.

Furthermore, time is a universal experience that connects us across the world. When it is 3 AM in Boston, it is also 3 PM in Beijing, and this shared knowledge allows us to communicate across vast time zones without social faux pas.

Disney movies like *Snow White and the Seven Dwarfs* [18] and *Beauty and the Beast* [19] bring ordinary objects to life, imbuing them with human-like emotions and behavior. What if a clock could have its own distinct character too? What if it had the ability to see and interact with humans in its unique way? This thought-provoking concept opens up intriguing possibilities for human-clock interactions that are both playful and creative.

Motivated by the desire to explore the intricacies of human-time interaction [17], I designed and built the Clo(o)k - a clock that looks.

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2 RELATED WORK

Previous research has explored the practical use of clock, such as visualizing upcoming event [7], tracking sleep patterns [10], and supporting planning and reflection [13, 15]. However, this work takes a more playful approach to clock design, aiming to create an interactive experience that encourages users to reflect on the concept of time.

In a similar vein, telepresence technology has used various sensory modalities, including sound [23], touch [3, 16], and sight [12] to enable people to feel the presence of others even when they are far apart. This work builds upon these ideas by exploring how time can be integrated into such interactions, creating new possibilities for connecting with others across time and space.

3 INTERACTIONS

This section showcases three interactive applications using the Clo(o)k, as depicted in Figures 2, 3, and 4.

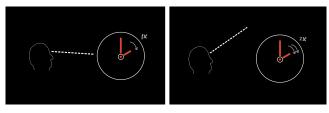


Figure 2: The Clo(o)k operates like a normal clock when the user is looking at it, but speeds up when the user's attention shifts away.



Figure 3: If the Clo(o)k notices that the user is engaged in conversation with someone, it stops moving to alleviate any concerns about time and allow for uninterrupted communication.

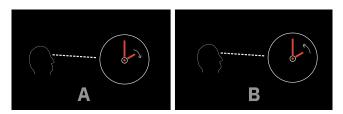


Figure 4: In the scenario where the user's loved one resides in a different time zone, if both parties look at their respective Clo(o)ks simultaneously, they will be able to see each other's current time.

4 CLO(O)K SYSTEM

This section details the design and construction process of the Clo(o)k. The relevant files are available for download at **zhuoyue-lyu.com/clook**.

4.1 Design

To achieve a simple and clean design for Clo(o)k, I used basic shapes, such as circles and triangles, to represent the clock face and base. The camera is positioned at the center of the clock face to maintain the appearance of a standard clock. This subtle placement allows users to initially perceive it as a normal clock, only to be pleasantly surprised by its intriguing behavior once they realize the central element is actually a camera. However, this design choice meant that the traditional clock mechanism, where all hands are attached to the centerpiece, could not be used. To overcome this, I utilized the hollow clock mechanism [21] - the minute and hour hands are two rings driven by two sets of gears hidden in the base (Figure 6).



Figure 5: The rings and the base fit perfectly.



Figure 6: These gears drive the rings.

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4.2 Fabrication

The 3D design was created using Fusion 360 [2] and Blender [9], and then exported as STL files to be printed. The rings and gears were printed with PLA using Prusa [20], while the hands were spray-painted red. The base (Figure 8) was printed using Fuse 1 [8] with powder for better quality.



Figure 7: The back cover is screwed to hide the components.

4.4 Software

Both ESP32-CAM and D11C were programmed using Arduino [1]. Although there is a reduced version of OpenCV [4] for ESP32-CAM, for more flexibility and convenience, a separate laptop running Python script using OpenCV [11] is used for facial detection, which gets the video stream from ESP32-CAM wirelessly. ESP32-CAM updates the movements of the stepper motors based on the information (number of faces) it receives from Python through the USB serial connection.



Figure 9: The camera sits at the center of the clock face.



Figure 8: The base that holds everything.

4.3 Hardware

Clo(o)k utilizes an ESP32-CAM [22] with a modified lens to capture the video, control one of the stepper motors, and wirelessly communicate with the computer and other clocks. A D11C [6] board was designed and milled to extend the pins of the ESP32-CAM so it can receive the serial signal from the ESP32-CAM to control another stepper motor. Two 28BYJ-48 stepper motors [5] with driver boards are used to control the rings. An FTDI Converter [14] is used to program ESP32-CAM and provide the power (Figure 10).

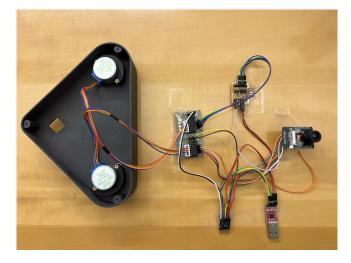


Figure 10: The electronics of the Clo(o)k.

5 FEEDBACK AND LIMITATIONS

Clo(o)k was showcased at an Open House event at the MIT Media Lab, attended by over 100 participants. Below are some of the feedback and comments gathered during the event.

- Attendees consistently smiled upon hearing about the user interactions with the clock, finding the exploration of time's dual nature – both subjective and objective – particularly intriguing.
- The minimalist design of the clock caught the attention of many participants, and they were pleasantly surprised to learn that the rings were detachable from the base.
- Several international students, who have loved ones living in different time zones, found the third interaction to be incredibly useful. They appreciated the ability to feel a sense of presence from their distant family and friends.

However, there are still areas for improvement that can be addressed:

- The poor lighting conditions affected the system's ability to accurately identify faces.
- The serial connections between ESP32-CAM and D11C were slightly laggy, resulting in a noticeable delay between the minute hand and hour hand.

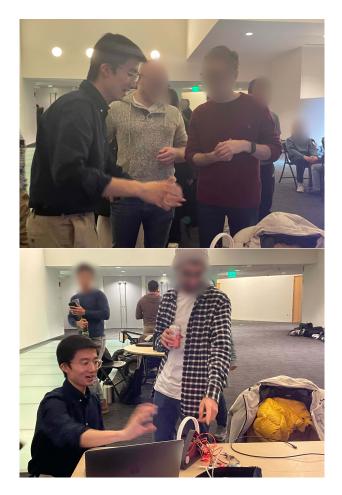


Figure 11: Pictures from the demo of Clo(o)k at the Open House event for MAS.863 class. (MIT Media Lab, Dec. 20, 2022)

6 FUTURE WORK

Clo(o)k is a versatile system that offers a multitude of potential interactions. The three interactions presented in this paper are just examples of what can be achieved. The detachable rings provide the opportunity to explore different ring styles and the novel interactions they can generate. For instance, users can customize their rings to suit their preferences (as shown in Figure 12 on the left), or turn them into storytelling devices (as demonstrated in Figure 12 on the right). As such, in addition to addressing the current limitations of the system and performing formal evaluations, further research will be pursued conducted to explore the vast possibilities for interactions that Clo(o)k can offer.

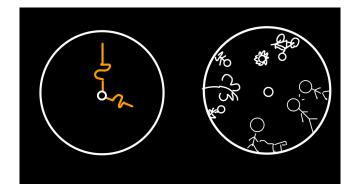


Figure 12: Customized ring designs.

7 CONCLUSION

This paper presents the design and build of Clo(o)k, a system that supports playful interactions with time. This work proposes an innovative approach to employing a tangible, everyday object for stimulating reflections on intangible concepts such as time. It is hoped that this research will inspire further exploration and spark new ideas within the CHI community.

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