

END-SEMESTER REPORT

ON

Eye Tracking

by

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ABSTRACT

This report is a culmination of the work done by Chirag Sharma(2022AAPS0301H) until 10th March 2025 under the guidance of Dr. Dipanjan Chakraborty for the CS F376 Design Project. As digital banking becomes an essential part of daily life, it is crucial to ensure its accessibility to all users, including the elderly. Many older adults face difficulty navigating online banking platforms due to complex interfaces, small text, or unintuitive layouts. Our study aims to identify the challenges that elderly users face by employing eye tracking technology to compare their gaze patterns and navigation behaviors while operating a net banking portal to that of a younger adult. By pinpointing areas where users struggle, we seek to provide actionable insights for improving interface design. The findings will help create a more inclusive banking experience, enabling older adults to manage finances with ease and confidence.

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1 Introduction

While digital banking is widespread, it often does not meet the needs of elderly users. Many online banking platforms are not designed with accessibility in mind, making financial management challenging for older adults.

Our study uses eye-tracking technology to analyze how elderly users interact with online banking portals. Participants will complete tasks on three different platforms, one familiar, one unfamiliar, and one modified for improved accessibility, while being monitored by an eye tracking device. By tracking gaze patterns and navigation behaviors, we aim to identify usability barriers and areas where these platforms fail to be elderly-friendly.

A pretest will gather demographic data and assess participants' technological experience, while a posttest questionnaire will collect qualitative feedback on comfort levels and aspects of the UI the user felt were difficult to navigate. We will also measure task success rates and the number of times participants request assistance. These insights will help guide the development of more intuitive and accessible online banking interfaces, ensuring a smoother experience for elderly users.

2 Eye Tracking Equipment

Before proceeding with development, it was essential to familiarize ourselves with eye tracking devices and pick one that suited our purposes. The options considered were:

1. **Pupil Labs Pupil core:** Pupil Labs glasses are a head-mounted eye-tracking device that provides high mobility. They capture real-time gaze data from a first-person perspective. The glasses offer high accuracy, and provide raw data that you can be manipulated as per need. However, they may require calibration and participant adjustment, and wearing a device for extended periods might cause discomfort for some users.
2. **Tobii T-120:** The Tobii T-120 is a remote eye-tracking device that attaches to a computer monitor, tracking gaze without requiring users to wear any equipment. This makes it non-intrusive and comfortable, especially for elderly participants. However, head movement restrictions and limited tracking in multi-screen setups could be drawbacks for certain applications. It does not provide any raw data.

Considering both of these we decided on the Pupil Labs glasses, as it allows for both screen tracking and provides raw data for us to process and analyse.

3 Device and Software Setup Guide

3.1 Initial Setup

The initial hardware setup is straightforward. Simply connect the device to your computer with the usb provided in the box. Once the device is connected, it requires the Pupil Core software bundle to function. The software and a detailed installation guide can be accessed at: . Pupil Labs Getting Started Guide.

Other useful links: • Pupil Labs Documentation • Pupil Labs Product Page

3.2 Configuration and Pupil Capture

After installing the Pupil Core software bundle, the Pupil Capture application is used to operate the device. Ensure that both the world camera and the eye cameras are properly detected. On rare occasions, the software may not recognize the headset. If this occurs, a system restart typically resolves the issue.

3.3 Calibration

Prior to each session, the device must be calibrated for each participant. The calibration process is tracking a moving dot on the screen while keeping their head as still as possible.

Detailed instructions are provided in the official guide.

Note: We faced a lot of issues trying to adjust the headset for different head sizes to get high confidence levels but the device. We particularly found an issue getting it to work on women due to different head sizes- leading to their low number in our testing population. Additionally, if the person has any form of eye condition or even high sight, this device could detect the eye at all.

3.4 Recording Sessions and Data review

To start just press the 'r' key. Each session is automatically saved. Pupil player app is included in the software bundle. It is used for reviewing and analyzing eye-tracking data. To get the csv files of raw data, drag and drop the 00X file (inside recordings folder) and press the download button. The csv files will directly be saved in the original 00X file.

4 Study Procedure

Eye movement patterns while interacting with software interfaces differ significantly between older users and a control group of younger users, suggesting that the same interface may not offer optimal usability for all age groups. This will be tested on 3 net banking portals, where the study will focus on identifying differences in visual attention and navigation behaviours, such as fixation durations, saccade patterns, and the focus on task-relevant elements. By pinpointing these differences, we can highlight specific areas of the UI that may require adjustments to enhance usability for different age groups.

4.1 Net banking tasks

After calibration of the device, the participant will be given the following tasks and be asked to execute them:

- **Login to account**
- **Check bank balance**
- **Transfer an amount**
- **Find the transaction details**

4.2 Details of The net banking portals

The participant will be asked to execute the tasks on 3 different net banking portals.

- **A familiar Netbanking Portal:** We have chosen to replicate the UI of the SBI bank for this.
- **An unfamiliar Netbanking portal:** We have chosen to replicate the UI of the Bank of America for this.
- **A Netbanking portal modified based on elderly friendly UI aspect:** This portal will have increased contrast, reduced visual clutter, larger text, and clear step-by-step instructions.

We randomized order of the three portals to eliminate any bias due to experience and re-calibrated the device for each interface.

4.3 Data collection

4.3.1 Pre-Test

We will have a short questionnaire prior to beginning the study to determine the background of the participant. It will be a comprehensive data set of demographic and technological experience such as:

- **Basic background:** Age, gender, education level, occupation
- **Computer / smartphone experience:** Years, frequency of use, common apps or websites used
- **Internet banking experience:** frequency, platforms used
- **Self-rated comfort with technology:** Rated on a structured 5-point scale

4.3.2 Eye-tracking Metrics

- Initial Area of interest (AOI)
- Number of AOI
- Fixation duration of each AOI
- Time spent on each page
- Heat map

4.3.3 Performance Metrics

- Task Completion time
- Task success rate
- Number of help requests

4.3.4 Post-Test

The Post-test questionnaire will collect the qualitative feedback from the experiment.

- Level of comfort
- What aspects of the UI were tough to understand
- Where in the task they felt stuck

5 Results

All data from questionnaires and Eye-tracking device and code that we used to extract the data can be found in references. We also made a table compiling the most important data and graphs.

5.1 Task Completion Time

On average, younger adults took the most time to complete tasks on HDFC, followed by SBI, and then the updated interface. For older adults, HDFC also took the longest time, followed by the updated interface, and then SBI. Compared to older adults, for younger adults, task completion times were higher for both HDFC and SBI, but significantly lower for the updated interface. We also observed that participants became increasingly comfortable with the interface as the experiment progressed, showing the highest confidence during the third test.

5.2 Fixations, Saccades and Pupil Dilation

The number of fixations and saccades followed the same pattern as the task completion time. Pupil dilation however appeared random.

5.3 SUS Scores (System Usability Scale)

Interestingly, based on the SUS scores:

- Younger adults preferred the updated interface (89.16), followed by HDFC (77.91), and lastly SBI (71.16).
- Older adults also preferred the updated interface (70), but ranked SBI (65) second and HDFC (52.33) last.

5.4 Familiar vs. Unfamiliar Interfaces

Out of six younger adults, four had prior experience with either HDFC or SBI. Surprisingly, all of them took more time to complete tasks on the familiar interface compared to the unfamiliar one. Among older adults, two out of three completed tasks faster on the familiar interface than the unfamiliar one, indicating a reverse trend.

5.5 Number of Areas of Interest (AOIs)

AOIs were derived from gaze heatmaps and are assumed to indicate the level of difficulty users experienced. For both older and younger adults, SBI had the most AOIs, suggesting

higher cognitive load. For younger adults, the updated interface had the fewest AOIs. In contrast, older adults had the most AOIs on the updated interface, indicating that it may have been more visually demanding or confusing for them.

6 Limitations to the study

Due to limitations in the eye-tracking device, it was unable to collect data from most women and individuals with eye conditions. As a result, these groups were excluded from the study, along with any challenges or preferences they may have had. Additionally, since all the interfaces were in English, we were unable to include members of the working staff who were not comfortable with the language. This led to the exclusion of a significant portion of India's population, resulting in a major loss of diverse experiences. Moving forward, it is important to ensure these groups are taken into consideration.

7 Conclusion

The updated interface, featuring larger fonts, clearer page navigation, and reduced clutter, was found to be more convenient by all younger and older adults. This was felt more strongly by younger adults-many of whom were either new or first-time users of net banking. Still, older adults were accustomed to certain design elements commonly found in existing net banking portals. For instance, they consistently looked toward the sidebar for navigation, whereas younger users focused on the center or top of the screen. When the updated interface deviated from these familiar patterns, older participants often struggled. As a result, an elderly user with limited digital experience might feel disoriented with the updated interface and equally confused by the complexity of existing portals.

An ideal net banking interface that caters to all age groups should therefore retain the basic structure of current platforms, while incorporating improvements such as increased contrast, reduced visual clutter, clear directional cues, and larger fonts. This hybrid approach can enhance usability for both experienced older users and digital newcomers.

8 References

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