Evolution of the Problem Scenario

Our project began with the observation that people often check their phone first thing in the morning in order to get information to prepare for the day. This includes checking the time, weather and schedules. But with how our phones and their notification systems are designed, it is easy for someone to lose focus with notifications coming their way early on.

We have thought of how we could help alleviate this problem by finding a common ground that people usually use which is a mirror! Everyone looks at themselves in the morning so why not put the information one needs on it.

As the project progressed, we noticed that our and with the low fidelity testing, we noticed that users preferred to have the freedom of changing where the widgets were as well as the brightness of them.

Our main problem scenario did not change during the project evolution but we did have the problem of how the user could obtain this freedom. We thought of making a mobile app in order to have a settings and admin page, but this would ultimately defeat our purpose of limiting phone usage during one's morning/night routine so we decided on adding a remote control to the system which would mimic a TV control system for easier mind mapping. Now the user is able to access their settings and brightness through the remote control.

Development of Usability Goals

- **Aesthetic and Minimalist Design**
  In our design we wanted only the essential information readily available to the user (date, time, weather and upcoming events from their calendar).

  This is one of our highest priorities. A cluttered mirror defeats its purpose, competing for attention rather than acting as a peripheral source. To address this, we specifically removed redundant information, such as the city name in the weather widget, as users already know their location. This ensures the device adheres to the principle that every pixel must serve a purpose.

- **Using the Mirror**

Users must be able to successfully use the device as a functional mirror while information is displayed. The UI must not overpower the reflection.

The device must function as a mirror first; information is a secondary feature. If the layout obstructs the user's reflection or the physical form does not fit the environment, the technology becomes intrusive. This goal drove our decision to move UI elements to the corners and allow the screen to be effectively "turned off" via brightness controls. As well as giving the users freedom to be able to move the widgets as they please.

- **User Control and Freedom**
Users must have agency over the display's layout and brightness to suit their specific environment and physical attributes (e.g., height or eyesight).

Different users have different mirror placements and lighting conditions. We prioritized features that allow users to reorganize the screen and adjust brightness immediately via physical buttons. This transforms the mirror from a "one-size-fits-all" device into a personalized tool. Users are also free to choose their location, their preferred degree (Celsius or Fahrenheit) and the option of synching their calendar. Even if the user sets these features, they may change them using the remote control.

- **Familiarity, Match between System and Real World**
Users should instantly recognize information through familiar conventions and terminology.

During rushed morning routines, cognitive resources are limited. Users should not have to decipher technical jargon. This goal led to renaming "Widgets" to "Display Elements" to avoid technical confusion and using standard gear icons for settings. We have kept the symbols the same, which are used widely for displaying weather symbols, and degrees. The remote control in the system provides familiarity with the TV remote. The user does not need to be touching the mirror in order to change its settings, similar to a TV experience they may change the settings with the remote control.

- **Error Prevention & User Trust**
Through our iterated user manual, the user will easily be able to understand any error that might occur through the Troubleshooting section. We also removed the calibration in order to take the load off the user and remove any hesitation they

might have during the calibration system. During setup, the user enters their location, calendar (optional) and personalization. The display will show their personalized mirror with ease which will in turn gain the users trust.

Functionality of Beta Prototype

Our beta prototype closely resembles our alpha prototype in the way that it has the mirror, remote controls and software (from our computer prototype) but during our informal heuristic testing we discovered some usability designs that would benefit our goals such as changing some of the mapping on the remote control, UI features and mitigating tedious hardware setup.

Addressing Minimalism and Glanceability

To satisfy the goal of **Aesthetic and Minimalist Design**, the Beta prototype, given by the feedback during our low-fidelity prototype, we have made the mirror bigger. This modification allows users to read information via a quick glance without stopping their routine. Furthermore, we removed the city name from the weather display, reducing cognitive processing time and visual clutter.

Ensuring Mirror Utility

To ensure the device meets the **"Use the Mirror as a Mirror"** goal, starting from the Alpha prototype we have implemented our own two-way mirror (instead of purchasing one) by using an acrylic sheet and plastic board since we were limited by resources. Additionally, we mapped the remote's volume buttons to brightness control, allowing users to dim the screen fully if they require a full, non-digital mirror experience.

Empowering User Control

Relating to **User Control and Freedom**, the Beta prototype includes a "Re-arrange Screen" setting. This functionality acknowledges that fixed UI positions may be obstructed by physical objects or may not suit users of different heights. By allowing users to move elements, the system adapts to the user rather than forcing the user to adapt to the system.

Reducing Friction and Cognitive Load

To address **Familiarity** and **Ease of Use**, we replaced the hidden "long-press" mechanism for settings with a visible, permanent gear icon. We have also added a go back feature to the func/stop button on the remote control. This minimizes cognitive load by relying on recognition rather than memory. We also implemented Google Calendar synchronization via a QR code, eliminating the frustrating experience of typing credentials with a remote and streamlining the setup process. To minimize frustration while setting up, we have implemented an auto-start service which boots up the software when the raspberry pi is powered on. So the user does not have to go into the pi and manually start the web server.