UNIVERSITY OF MIAMI
Department of Interactive Media

Air Traffic Management Integrated System

Joanna Minott - Interactive Media, M.F.A. Candidate
Sofia Perez-Baux - Interactive Media, B.S. Candidate
Noel Nuñez - Interactive Media, M.F.A. Candidate
Caragan Olles - Creative Advertising, B.S.

Faculty Advisors:
Sanne Martens - Professor, Department of Interactive Media
Kim Grinfeder - Associate Professor, Department of Interactive Media

QUAD CHART

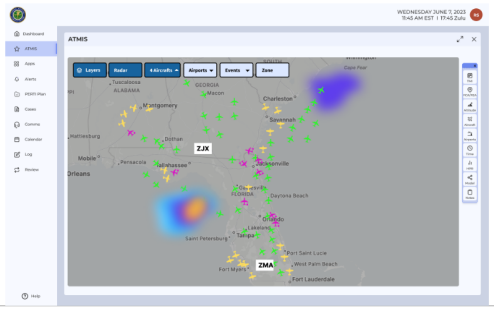
University of Miami
Air Traffic Management Integrated System

TFM-AID
TRAFFIC FLOW MANAGEMENT - APPLICATION INTEGRATION DESIGN CHALLENGE

Project Description / Requirements

- The Air Traffic Management Integrated System (ATMIS) is a modernized interface designed to improve the workflow of traffic managers by providing a customizable layout that focuses on relevant information, minimizes user errors, and maximizes productivity.
- The location of applications and tools is optimized for efficiency throughout a workflow, reducing the number of user actions and clicks.

Image/Graphic:



Risks / Issues

- New interaction paradigms could result in increased development time and a higher risk of errors or bugs.
- Compatibility issues, data migration, and potential disruptions during the implementation phase are possible issues.
- As multiple applications and functionalities are consolidated into one platform, ensuring optimal system performance, responsiveness, and stability becomes critical. Extensive testing and optimization will be necessary to deliver a seamless experience.

Next Steps

1. Continue to conduct testing through heuristic evaluations and usability studies.
2. Review any additional insights learned on how to improve our system and the overall user experience.
3. Continue to test with traffic managing experts and other FAA personnel to ensure the functionality and usability is as optimized to the fullest.

TECHNICAL REPORT

Summary Statement

The Air Traffic Management Integrated System (ATMIS) is a modernized interface that improves the workflow of traffic managers at the Command Center. The ATMIS offers a flexible and customizable layout that allows traffic managers to focus efficiently on the task at hand, receive the most relevant information, maximize productivity, and minimize user error. Our goal is to reduce the number of intermediate clicks and maneuvers that need to happen within the interface and different applications to complete a workflow. The most efficient way to work is to spotlight only the information that you need to see in that instant. Our system strives to achieve this feature as closely as possible. Each individual traffic manager will be able to set preferences specific to them and what works for their specific workflow. In a fast-paced environment, efficiency is key, and having tools that work with you is crucial for productivity.

As we continued to design, and further develop ATMIS and based on the feedback we received, we no longer had a need to outline the initial four pillars of the design (Application Library, Notification Center, Documentation Log, and Communication Hub). Instead, we integrated the pillars together to assist the user seamlessly throughout a workflow. Although all four of these aspects still exist within our design, we have altered how they interact with the user with the overarching goal of simplifying the non-linear workflow of traffic managers.

In our initial designs, we had a consistent design that still utilized existing traffic management applications and placed them in the Application Focus Area. Understanding that that approach may run into challenges similar to the current Traffic Flow Management System (TFMS) challenges, our design now functions as a universal dashboard with ATMIS being a streamlined application to consolidate and simplify the monitoring, modeling, logging, and reviewing stages of a workflow.

The system designed is an application that serves as a host for an application suite. With clear design guidelines, a style guide, and a component library, each native application can be overhauled to create an integrated, seamless, and consistent experience. This allows the application to be designed in phases, where the Minimum Viable Product (MVP) consists of the main functionality of the application and can be rolled out gradually. This will enable current TFMS users to continue using legacy applications and place them onto their own customized canvas as they adapt to the new design changes. Meanwhile, new users or users who are ready to transition to the new system immediately can launch the ATMIS application for the complete experience. This will allow for a smoothed, phased transition with the least interruptions to the workflow.

The design maintains the same look and feel throughout, ensuring consistency. One of the pain points traffic managers using the current system may face is inconsistency in the graphical user interface (GUI) from application to application, resulting in a heavier cognitive load for users to learn different behaviors and interactions. This takes away from the traffic management task at hand. Our solution is to create consistent graphics and elements throughout, easing the load on traffic managers.

The application focus area provides a central space on the canvas where users can view and interact with different components. It is fully customizable, allowing users to move applications around and resize them to fit their needs. However, there is a limit to the number of applications that can be opened at the same time before some need to be closed. This approach ensures a focused and decluttered workspace.

The application library will house all applications for easy accessibility. However, frequent access to the application library will not be necessary as there will be a more efficient way to access the spaces users need to monitor, model, log, and review Flow Constrained Areas (FCA), Flow Evaluation Areas (FEA), and Airspace Flow Programs (AFP). This will be achieved through promoted next steps and quick access buttons, which will guide users to their next task based on their current one.

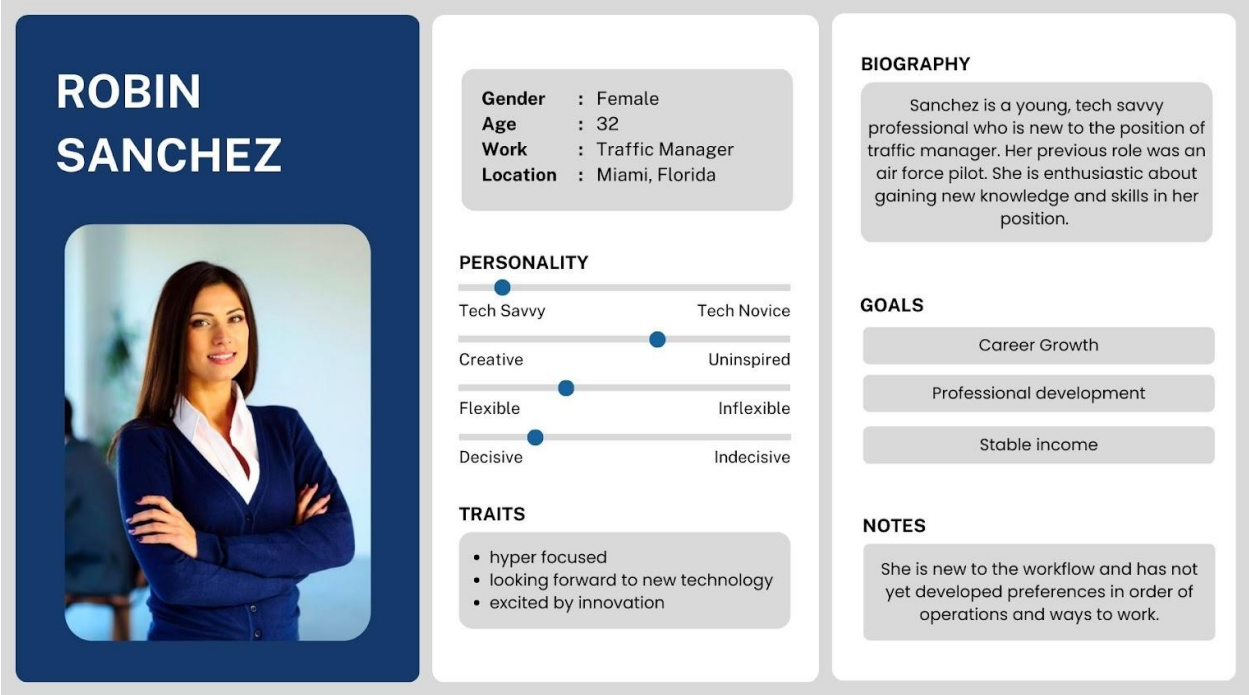
The system includes webinars, messaging, file sharing, and screen capture tools. The look and feel of ATMIS draw inspiration from existing applications and software such as Apple, Google Suite, Microsoft Office, and other well-known systems. This intentional approach aims to minimize the learning curve required when implementing a new system. The design also offers a light and dark mode that users can switch between based on their preferences.

The innovative design solutions directly address the objectives of Flow Management Data and Service (FMDS) by enhancing user workflows, improving multitasking capabilities, and minimizing errors and distractions. The implementation of features like the notification center and alert banners keep traffic managers informed and focused on critical issues, while the communication center and calendar foster efficient collaboration among traffic managers and National Airspace Stakeholders (NAS). The incorporation of a database of past cases and modeling based on relevant cases further enhances efficiency and provides a valuable starting point for traffic managers. Overall, ATMIS will help traffic managers work more efficiently and effectively, ultimately contributing to improved management of the NAS.

Project Description

To ensure the usability of the ATMIS design, we considered two different personas to gain an understanding of the various perspectives that traffic managers may have. These personas represent different personality types and personal traits that traffic managers may possess, such as being open to change and innovation or having established ways of working in the current systems. By examining these personas, we were able to adopt a more user-centric approach to design, ensuring that the system is not only functional but also intuitive.

These personas were developed through research and interviews conducted with former command center traffic managers and current traffic controllers from the Miami Air Route Traffic Control Center (ARTCC ZMA). Additionally, we engaged in frequent communication with a retired National Air Traffic Management Specialist from the Command Center. Their input provided valuable insights into the user experience and daily usage of the current FMDS system. Based on these conversations, we established guidelines to create a more efficient workflow and streamline data for the users.



Robin, for instance, would be inclined to use ATMIS immediately, as it offers a consolidated and modernized experience. Being familiar with using Google Suite and preferring a system that aligns with her existing knowledge and interface preferences, she is eager to start working with the newly designed system.

On the other hand, Edward would be more inclined to utilize the legacy applications from the current TFMS system, which have an updated look and are accessible through the application library. He would then assemble them on a canvas to create his own integrated system. As he becomes accustomed to the look and feel of the updated applications, he will gradually transition to the new design and begin fully utilizing ATMIS. The availability of legacy applications on the new dashboard and application focus area is crucial for the success of Edward's persona. Since he is already familiar and comfortable with the current TFMS system, allowing him to continue using the existing applications on the new platform will facilitate his transition. As he grows more comfortable, the newly designed applications can be integrated, ultimately enabling him to transition effortlessly to ATMIS.

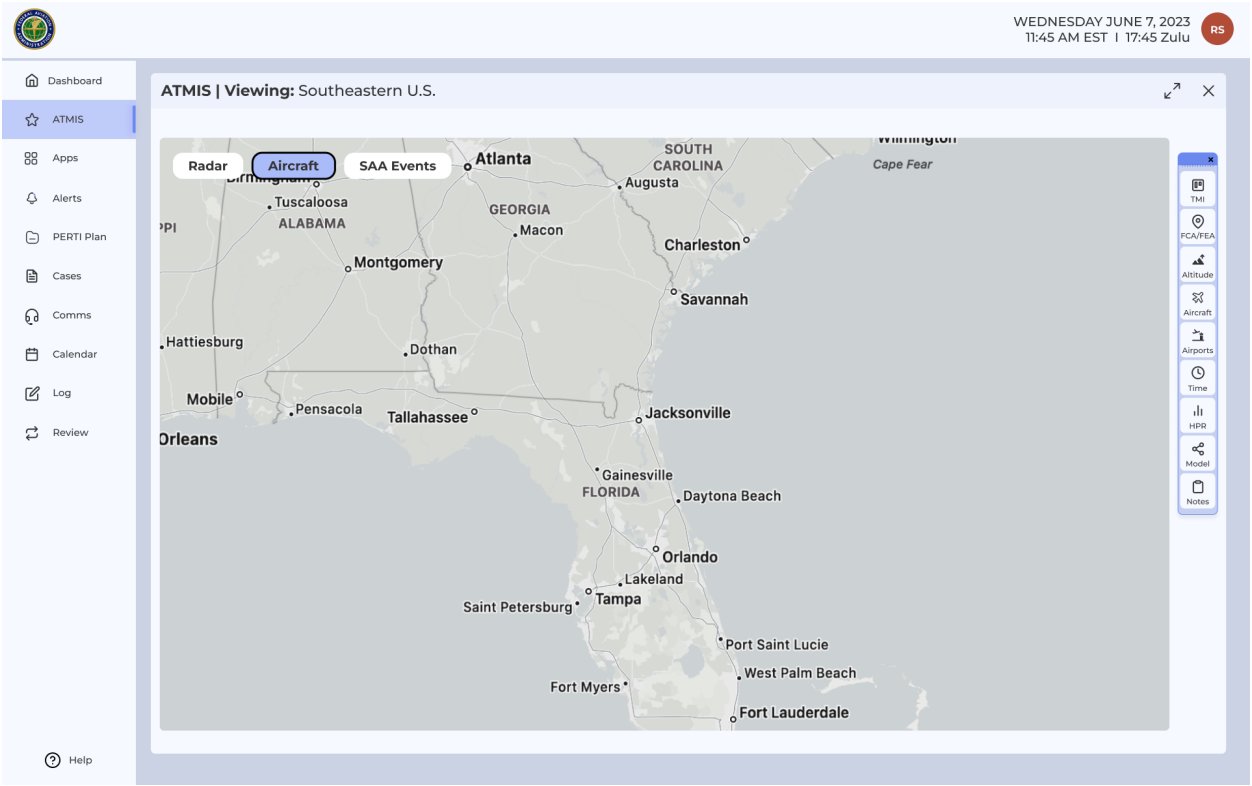
One of our primary design objectives is to minimize the number of clicks and actions required to access the data that traffic managers need. This goal emerged from our observations at the ARTCC ZMA, where we witnessed the functionality and interactions of the current FMDS interface with various applications. In the wireframes and prototypes presented below, you will observe how we have revamped the navigation tools and strategically positioned tools around the canvas, effectively reducing the amount of mouse movement necessary.

The dashboard was designed for 24.0 inches of a viewable area, 1920 x 1200 pixels, with a native resolution of @60 HZ. The entire dashboard is scalable and can be viewed on as many monitors as available to the user or just one monitor, as well as viewable from up to four feet.

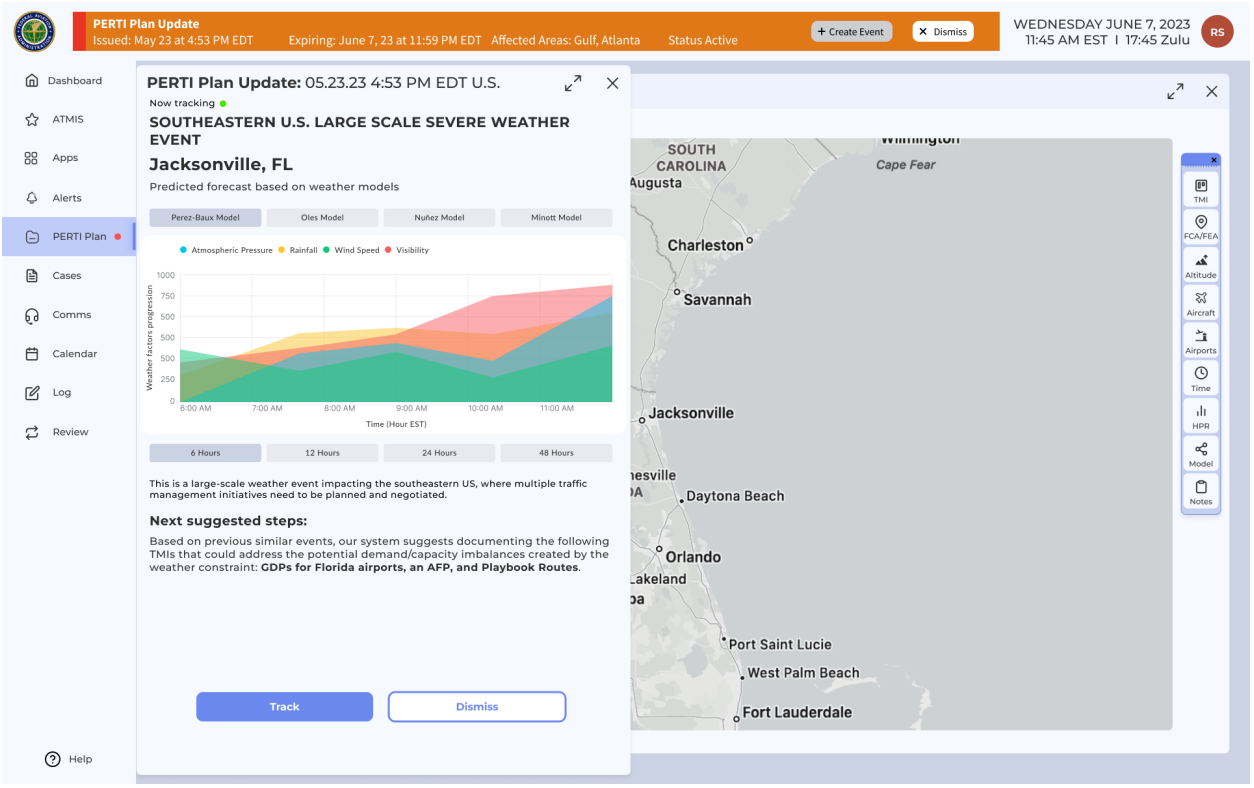
We, from our previous design, reduced the percentage of black seen on the screen to reduce eye strain and instead used darker grays for distinction in color.

Our design solution incorporates a multitude of thoughtful features that enhance the user experience to exceptional levels. With a dedicated emphasis on innovation and creativity, we have completely transformed the dashboard, resulting in a remarkably effective solution. Now, let's delve into the essential aspects that distinguish our design approach.

At the heart of the dashboard lies a universal set of navigation and design features. While these elements remain fixed, they adapt seamlessly to multiple monitors, ensuring a consistent and intuitive user experience. The top header offers essential information such as the system logo, date, time (both local and Zulu), and admin login for effortless user switching and personalized preferences.

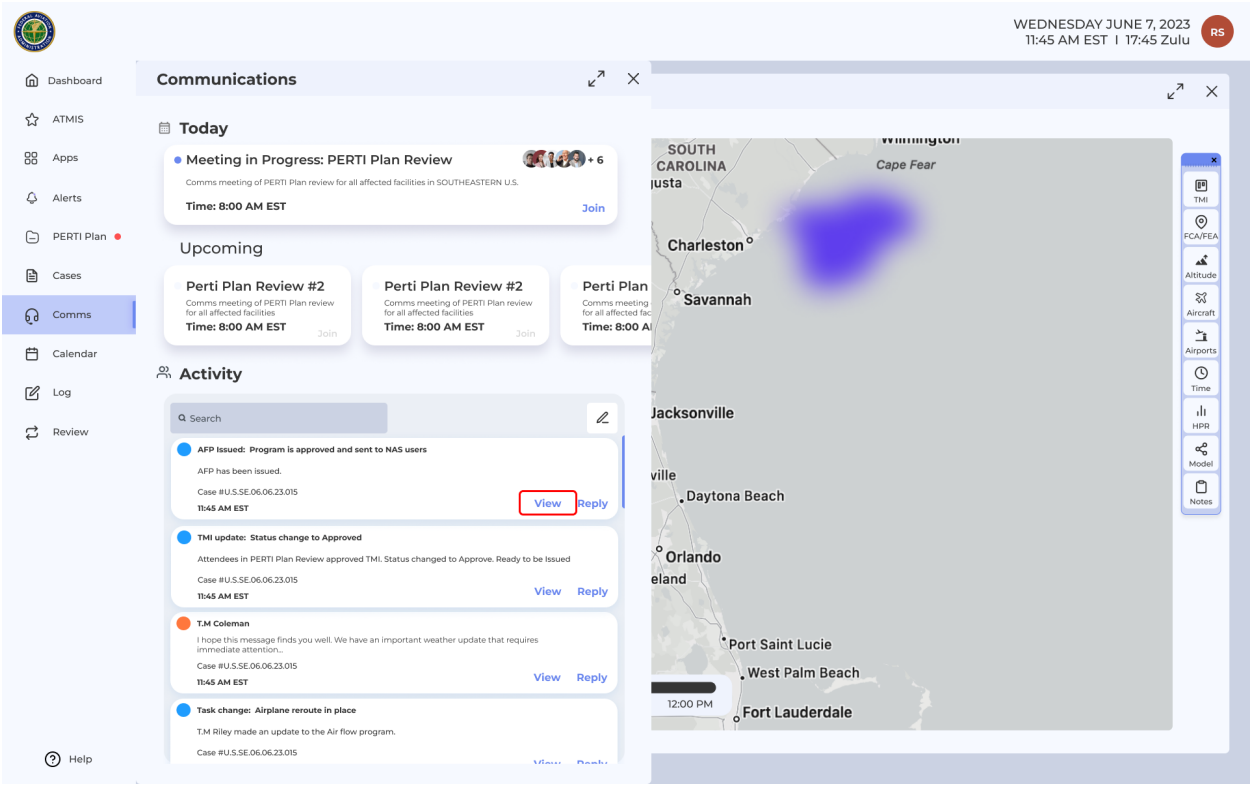


We have strategically positioned the Main Navigation on the left-hand side, based on extensive research on user behavior patterns. By relocating it from the right side, we optimize accessibility and minimize eye movement, especially when multiple monitors are in use. Leveraging our innate reading left-to-right inclination, the left-hand placement of the Main Navigation serves as a reliable anchor for users. Within the Main Navigation, ATMIS can be launched and the home application of the map with open cases will appear. The Apps section houses an extensive library of new and existing TFMS applications. The Alerts tab serves as a centralized repository for all notifications, with a red dot indicating new or updated alerts. Similarly, side navigation apps also employ red dots to signal changes or pertinent information that requires attention.



Further, along the Main Navigation, users can access the PERTI Plan section, where new plans are showcased alongside any modifications. The Cases section displays a comprehensive collection of past cases, each uniquely identified by country, region, date, and case number. This will allow users to look at past cases and be able to model their new cases with historic evidence to support their decisions. The Cases section will come into play in the workflow and automatically bring up similar cases when there is a new weather event that requires an AFP. The Communication tab fosters seamless interaction between traffic managers, the NAS, and other control centers. There users can review plans and communicate with NAS and control centers to ensure their AFPs will be successful and effective for all parties affected. Additionally, the Calendar tab ensures efficient scheduling of webinars, meetings, and tasks within the command center. With Log (NTML) and Review users can effortlessly navigate to their preferred destinations. When these tasks within the workflow are selected, it will bring users to an application view with the necessary applications open to complete that task.

To enhance usability, each tab within the Main Navigation changes colors upon hovering and triggers a side panel upon clicking, providing quick information and a sneak peek into the content. This user-friendly feature eliminates the need for users to fully close their current task to reference, for example, the PERTI Plan or check on an alert.



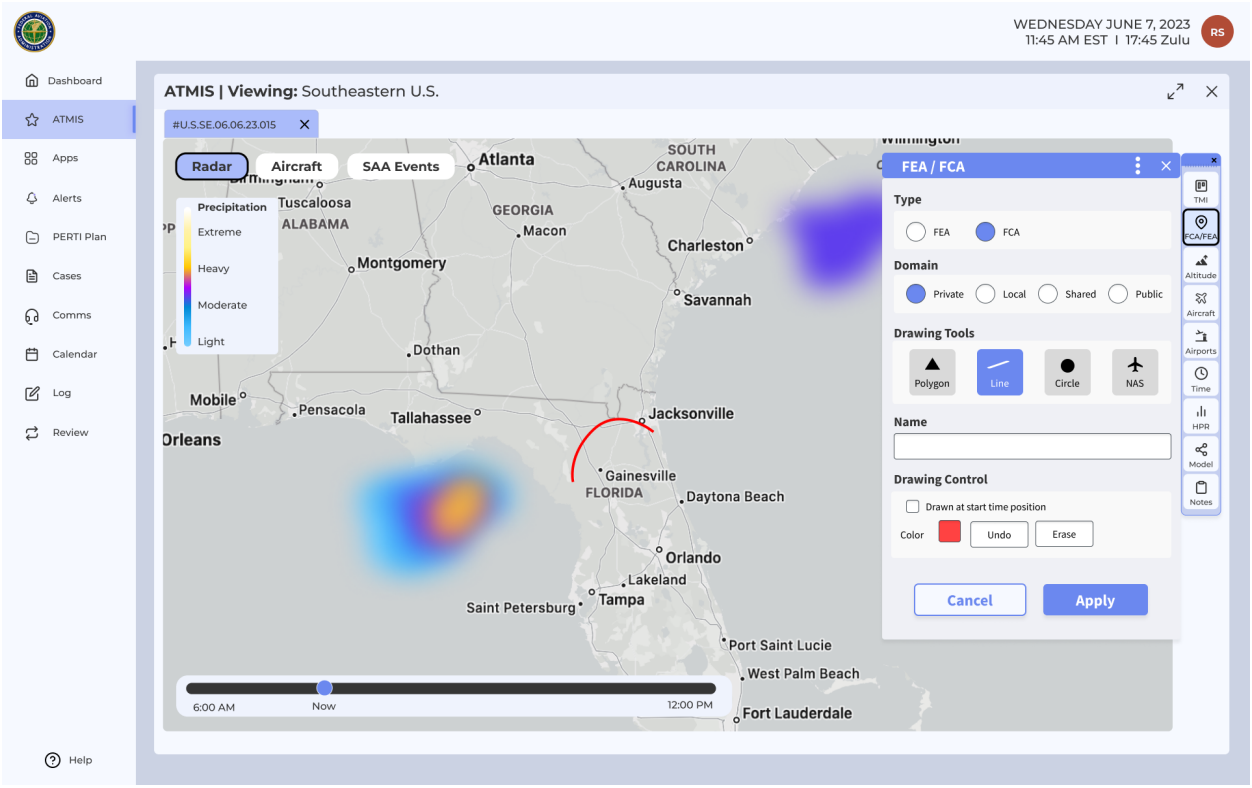
Our design extends beyond the Main Navigation, offering a fully responsive and customizable main dashboard. Upon login, users are greeted by a dynamic landing page featuring a map with current parameters, intuitive filter selection tools, and real-time weather conditions. The alert center promptly displays the most urgent and recent alerts, while the cases application showcases the currently open cases. Hovering over each subsection within these applications unveils additional information, eliminating the need for exhaustive clicks.

The applications on the dashboard can be closed, resized, and rearranged to suit individual preferences. As additional applications are opened, the existing ones automatically adjust to accommodate the new additions. To maintain a focused and uncluttered workspace, our design enforces a limit on the number of simultaneously opened applications. Should users choose to close an application, they can effortlessly retrieve it from the application library within the Main Navigation.

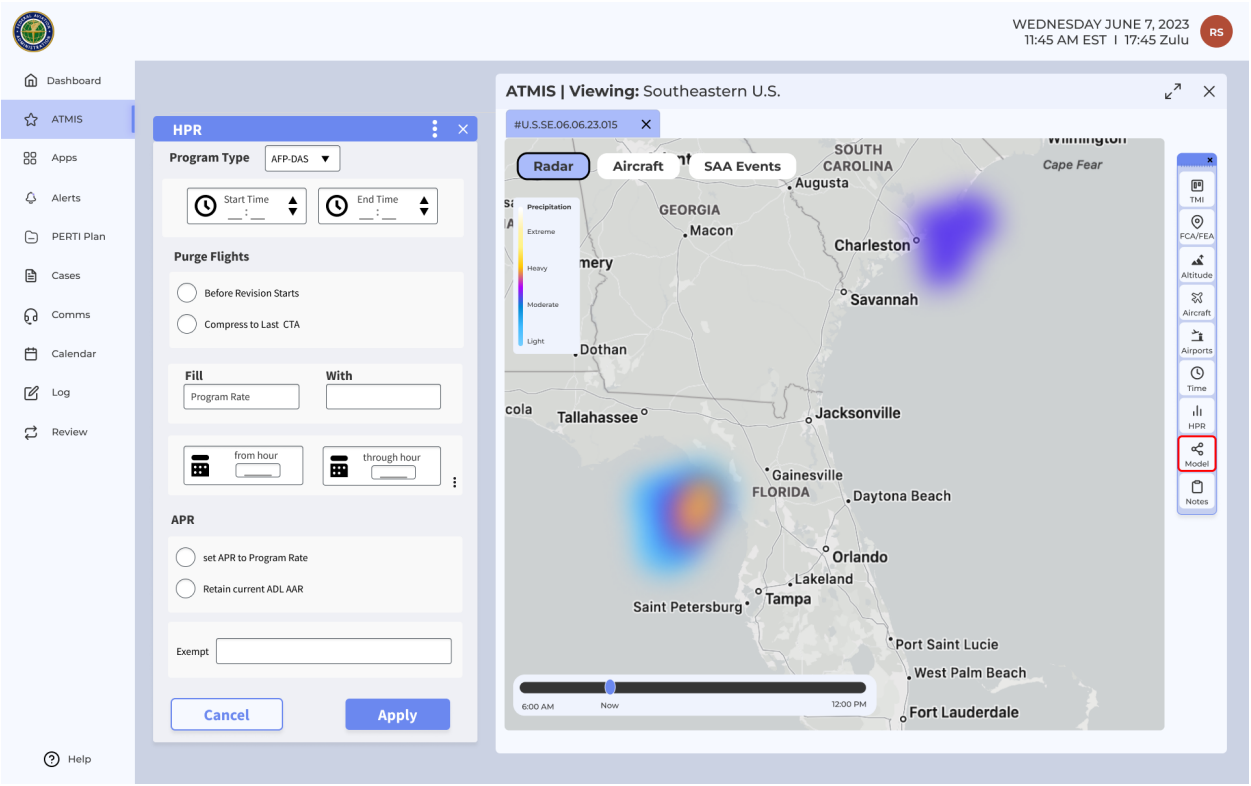
Rapid recognition of attention-worthy items and efficient task completion is central to our optimized design and streamlined workflow. Interactive design elements, such as color and background changes upon hovering, align seamlessly with modern industry standards and User Interface (UI) design trends, further enhancing the user experience.

The following workflow has been outlined for a traffic manager utilizing the innovation and accelerated processes of this design and ATMIS. This workflow goes over login, planning and creating cases, filtering and setting parameters, reviewing communications, creating an FCA, modeling, revising the traffic management initiative (TMI), approval of the TMI, issuing an AFP, modifying an AFP, canceling an AFP.

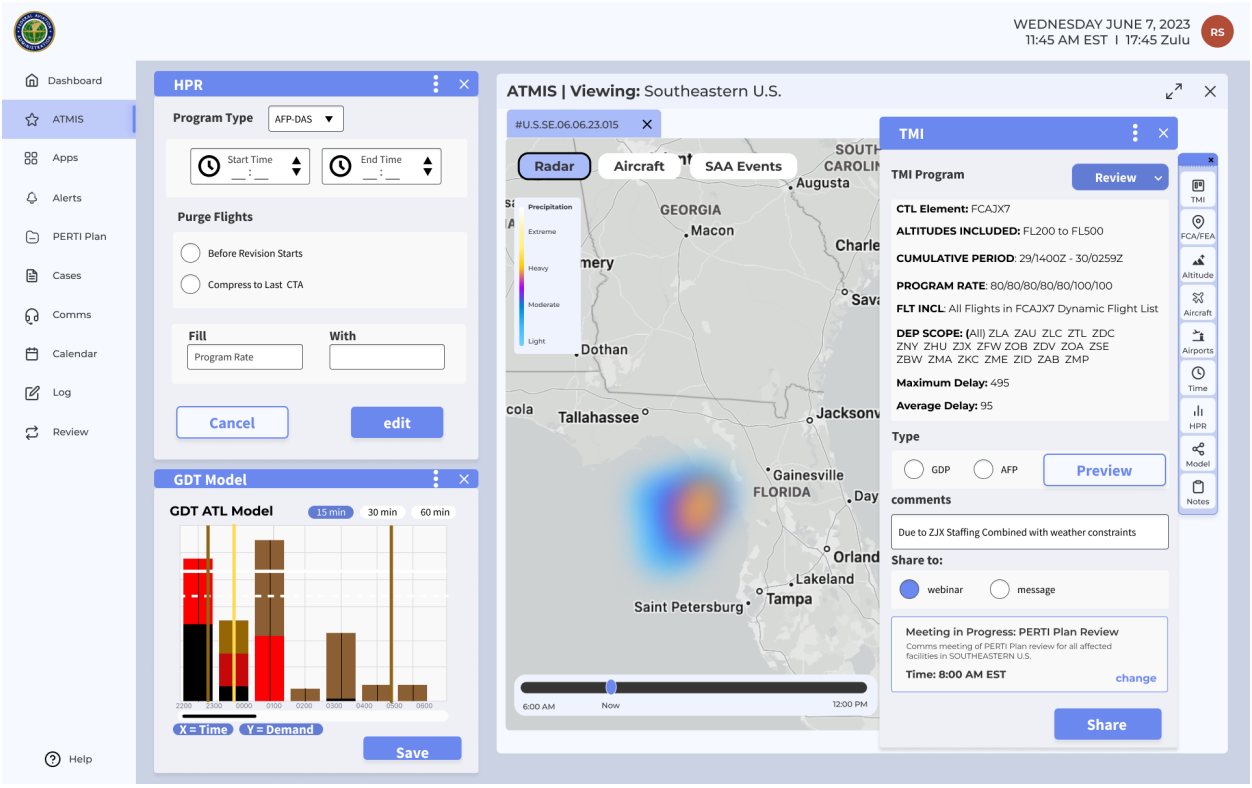
The traffic manager logs into ATMIS and lands on the default view, which is the monitoring stage displaying the map and filters. When a notification for a new PERTI plan appears, the traffic manager navigates to the PERTI plan using the notification. They select the plan, causing an information panel to slide out. From there, they choose to create a case based on the PERTI plan, and the menu closes. The case ID is shown and generated based on the location and date. The traffic manager sets filters to focus on weather only and adjusts all parameters, such as vehicle type and airports. They open the "TMI" tool to send a message to facilities and NAS stakeholders. In the communications area, they review feedback and make adjustments to the modeling. After reading the full message, they close the communications overlay, and the map fills the focus area.



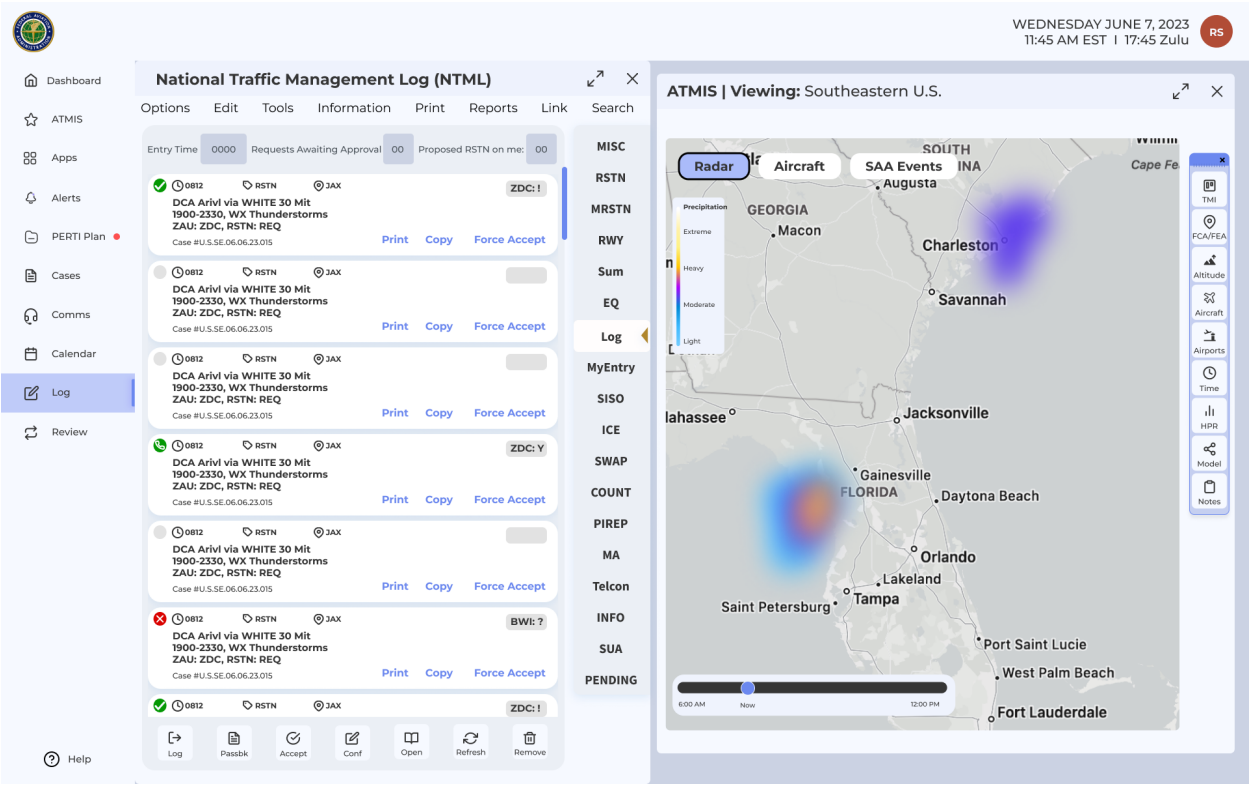
Using the FCA/FEA tool, the traffic manager selects FCA, draws the FCA line on the map, and proceeds to model using the Hourly Program Rate (HPR) tool. The HPR and model tools are torn off and positioned next to the map.



After modeling and saving, the traffic manager goes back to the TMI tool for TMI delivery, modifies the original message, and sends it to NAS users. Upon receiving a notification, they expand the communications menu and review the agreed-upon TMI. They close the model and HPR tools, and the map becomes the entire focus area. Returning to the TMI tool, they choose the type of TMI, preview it, and issue the AFP.



After the AFP is delivered, the traffic manager reviews it, makes adjustments if needed, and opens the TMI tool to update the AFP. They issue the modified AFP, receive a confirmation, and close the overlay.



Another notification appears, prompting them to go to communications, where they see the status change. Finally, they close the case tab, which automatically sends the closed case with all pre-populated data to the NTML, and the workflow repeats itself.

As technology rapidly advances, having systems that can advance along with it is the only way to efficiently stay on top and take advantage of new technologies. The ATMIS was designed with this in mind. Our design concept is compatible with touchscreen devices. All possible touch targets were sized to 44x44 pixels to accommodate the addition of a touchscreen. There are several actions and tasks traffic managers must complete that can be aided by the implementation of touchscreen devices. For instance, within the application focus area, users can drag and drop applications and pinch in and out with quick hand motions. Response haptics can respond to the user interacting with applications as they tap and drag. If a user only wanted to look at a specific section of the United States for weather, they could draw an area with their finger to view a precise sector and not have to rely on preset system constraints to show them more information than what they wish to see. A hardware input (mouse and keyboard) will still be necessary for data entry and personal preference of using a mouse over a touch screen. Our goal is for the Traffic Management Unit (TMU) to stay as up-to-date as possible while prioritizing that these updates will benefit users in terms of efficiency and effectiveness of workflow.

Our design process revolved around a user-centric approach, ensuring that the needs, preferences, and behaviors of the traffic managers were at the forefront of our decision-making. By conducting extensive research, interviews, and consultations with past command center traffic managers, current traffic controllers, and industry specialists, we gained valuable insights into their experiences and expectations. This allowed us to create an intuitive and seamless user

experience that enables traffic managers to accomplish their tasks efficiently and with minimal cognitive load.

Recognizing the importance of an optimized workflow, we dedicated ourselves to reducing unnecessary clicks and actions required to access critical data. Our observations and interactions at the Miami Air Route Traffic Control Center (ARTCC ZMA) played a pivotal role in shaping our design choices. By renovating the navigation tools and strategically placing essential features and tools around the canvas, we significantly minimized mouse movement and streamlined the entire workflow. The result is a system that empowers traffic managers to swiftly access the information they need, enhancing their productivity and decision-making capabilities.

Acknowledging the importance of a smooth transition, we have incorporated legacy applications from the current Traffic Flow Management System (TFMS) into our design solution. This deliberate inclusion caters to the needs of traffic managers like Edward, who prefer the familiarity and comfort of the existing system. By allowing these applications to coexist within the new dashboard and application focus area, we ensure a seamless transition for users, gradually introducing them to the newly designed features and applications of our system, ATMIS.

Leveraging the success and user-friendly interfaces of renowned systems such as Apple, Google Suite, and Microsoft Office, we drew inspiration to create a cohesive and visually appealing design for ATMIS. By incorporating a familiar look and feel, we aimed to reduce the learning curve typically associated with implementing a new system. Users like Robin, who favor modernized systems and are already acquainted with similar interfaces, will find a welcoming environment in ATMIS, enabling them to dive into their tasks with ease and confidence.

By adopting a user-centric approach, streamlining workflows, integrating legacy systems, drawing inspiration from established interfaces, and aligning with FMDS objectives, we have crafted a solution that is efficient in improving traffic management. We are confident that our design will optimize the way traffic managers operate, ultimately contributing to enhanced management of the National Airspace System.

Technical Risks of Design

The concept of the ATMIS design showcases enhancements that are aimed at providing users with a more intuitive and seamless experience. The changes are expected to increase the overall usability of the system and make the traffic management workflow more user-friendly. A challenge that could arise from introducing new interaction paradigms and merged functions is that it could result in added complexity to the development process through increased development time or a higher risk of errors or bugs. It is, therefore, critical to assess the potential risks and challenges associated with implementing the proposed system. To mitigate these risks and ensure the ATMIS design is implemented successfully, a complete redesign of the current system may be necessary. This will require an assessment of the system’s current state. While a complete redesign may be more time-consuming and resource-intensive, it could ultimately result in a more efficient and effective user experience.

TEAM DESCRIPTION

Our team is composed of a diverse group of individuals at varying academic and professional levels who bring different perspectives and skills to the design process. The faculty advisors are able to bring their professional experience and academic background in interactive media to provide guidance and support. The graduate and undergraduate students offer advanced knowledge and skills in areas such as User Experience Research (UXR) and data visualization, bringing fresh ideas to the team.

Each member of the team has specific focus areas, allowing for a comprehensive approach to the development and design of the ATMIS. Those working on UXR conduct research to understand user needs and behaviors and then apply that knowledge to the design of the interface. Data Visualization designers use visual storytelling techniques to present complex information in a clear and consistent manner. UI designers create the visual elements of the interface and components, such as buttons, menus, and icons, to make them intuitive and easy to use. As a team, all members concept by generating ideas and creating ways to explore different design directions. Additionally, each member conducted industry research to stay up-to-date on trends and best practices in the field, ensuring that the team is always informed and able to offer innovative solutions. Throughout this process, organization and documentation have been crucial in keeping the team on track and ensuring all of the work is well-documented and easily able to build off and take ideas further into development.

Joanna Minott is a first-year graduate student pursuing a Master of Fine Arts in Interactive Media on the User Experience (UX) design track. She earned a Bachelor's Degree in Computer Science. She has past experience in mobile and web design, designing cross-devices to create cohesive systems. On the team, she is a UX researcher, UI designer, and prototyper. She brings her knowledge and eagerness to learn to conceptualize for the design process.

Sofia Perez-Baux is an undergraduate student pursuing a Bachelor of Science in Interactive Media. She is a UX researcher, UI designer, and prototyper for this project. She worked to ensure that the user experience was optimized and that the interface was intuitive and easy to use. She worked to collect research on human factors and applied creative thinking and this knowledge to propose several ideas for new features that could be integrated to enhance the user experience. She has experience creating virtual experiences and previously worked as a digital engagement intern for the Perez Art Museum in an art museum where she was responsible for replicating existing museum exhibits and creating interactive components in virtual reality.

Noel Nuñez is a Student Success Advisor at the University of Miami. He is also taking classes in pursuit of a Master of Fine Arts in Interactive Media. For this project, his responsibility was to oversee the video documentation process to create a compelling and informative video that would communicate our solution for traffic managers. He was incremental in the design process, creating hand drawn storyboards and detailed user flows. He also did extensive research into the FAA industry and looked at the TMU to understand the complexities and intricacies of air traffic

management. With the collected information and information provided, he worked to consolidate and organize it in a clear and concise format.

Caragan Olles graduated in May 2023 and earned a Bachelor of Science in Communication majoring in Creative Advertising. She is a copywriter and creative conceptor and has experience as a digital marketer focusing on social media campaigns. She currently works as a freelance marketing specialist for a digital marketing agency and a freelance social media content creator for a copywriting agency. She worked closely with the team to be a part of the creative process while taking notes for documentation purposes, ensuring the team had a clear record of the design process. She was able to watch the design process in real-time as the UI designers worked, gaining an understanding of the choices they made and the impact those choices will have on traffic managers.

Sanne Martens is an experienced User Experience Specialist and the faculty lead of the team. She has more than 15 years of professional experience in the industry, working on mission-critical product design and commercial communication products in both hardware and software. She is a Professor of Practice at the University of Miami Department of Interactive Media. She shares her knowledge and experience with her students and encourages a user-centric approach to the project.

Kim Grinfeder is an Associate Professor of Interactive Media and Director of Human Centered Design and Computing at the Institute for Data Science and Computing. His area of creative research is centered on immersive media. He helps to keep the designs focused on what is best for the user at all times.

Together, our team is able to cover a wide range of expertise and experience, allowing them to approach each project with a comprehensive understanding of the design and development of ATMIS. Each member plays a crucial role in the development and design of the interface. Through collaboration and innovation, we strive to create a functional and aesthetically pleasing solution that provides an enjoyable and efficient user experience.

PROJECT PLAN

Our team followed key user interface guidelines to ensure a user-friendly experience. We used color strategically, employing it to enhance the meaning of information by highlighting important elements and making them stand out from the background. Symbols were employed to represent objects and actions, ensuring simplicity and ease of understanding. The clear and concise text was used to provide information that is both readable and comprehensible. To present a list of options, we utilized menus organized in a logical manner. Windows were utilized to display related information in separate areas, allowing for effective grouping. Input devices were chosen to facilitate user interaction, prioritizing ease of use and comfort. In designing the interfaces, human factors such as workload, fatigue, and stress were considered. We incorporated checklists to ensure correct procedure adherence, ensuring they were concise and user-friendly.

Finally, regular evaluations were conducted to assess the effectiveness and efficiency of the user interfaces.

Developing software that requires high-security levels entails certain risks, and the government provides valuable recommendations to mitigate them. First and foremost, secure coding practices should be followed during the development process to minimize vulnerabilities. Thorough security testing must also be conducted to identify and address any potential weaknesses. Additionally, implementing a strong password or employing another reliable authentication mechanism is crucial to protect the app's integrity. Regular updates, including timely installation of security patches, are essential to stay ahead of emerging threats. By adhering to these guidelines, software developers can ensure that their applications are developed safely and securely, minimizing the risk of security breaches.

A style guide and components guide were created for continuity and consistent views across all applications. These guides serve as a blueprint for maintaining continuity and ensuring consistent views across all applications. By adhering to a predefined set of design standards and guidelines, developers can achieve a unified visual identity and user experience throughout the software ecosystem. This not only enhances the overall brand image but also facilitates user familiarity and reduces the learning curve when transitioning between different applications. Moreover, a style guide and components guide can prove invaluable when it comes to the development of legacy applications. By incorporating these established design principles into existing software, developers can modernize the user interface, improve usability, and harmonize the user experience across all applications, regardless of their age or technology stack. In this way, a style guide and components guide promotes efficient development practices and help maintain a cohesive and polished software ecosystem.

We started with a sprint plan, where we scoped and planned the required features. We developed multiple one-week sprint plans where we ideate, prototype, and test a small part or feature of the project each week. That approach helped us to test the design concept's quality to ensure that we were staying on track and that each component was something that benefited the user. We broke down the project into smaller parts and focused on specific features at a time to ensure they were functionally optimal before moving on to the next.

During the development stage, the focus was on maturing the system to include a more robust feature set with enhanced functionality. We analyzed the requirements of the users and identified areas where the system could be improved to better meet their needs. Our focus was on optimizing the seamless integration and efficient, natural flow for the users. In this stage, we created a prototype to be able to test and validate the design concepts before final implementation. Through testing, we identified any challenges users may have encountered.

We were committed to pushing for innovation and exploring how we could optimize our design by implementing user-friendly and intuitive input and output methods. In addition to improving the UX, we created and continued to use a uniform design language for our design. This included developing a comprehensive style guide and component library that covered everything from colors to fonts to components. By standardizing the design language, we ensured that our designs had a consistent look and feel, which helped to build cognitive recognition. Furthermore, this

approach made it easier for users to navigate through applications and reduced the learning curve associated with using new software.

Our approach involved conducting usability studies, tests, and heuristic evaluations as previously outlined in the planned testing section. The results of these tests combined with feedback from judges after reviewing our proposed design were then implemented into continuing development and design of the system. After each new major design, more testing and evaluation were conducted to ensure the system was optimally user-friendly.

The primary challenge we faced was managing time and task allocation. The University of Miami's Spring 2023 semester concluded in the first week of May. Some team members graduated and began full-time positions. This added an extra layer of difficulty when it came to collaborating with each other.