UCD School of Information and Communication Studies | UCD iSCHOOL

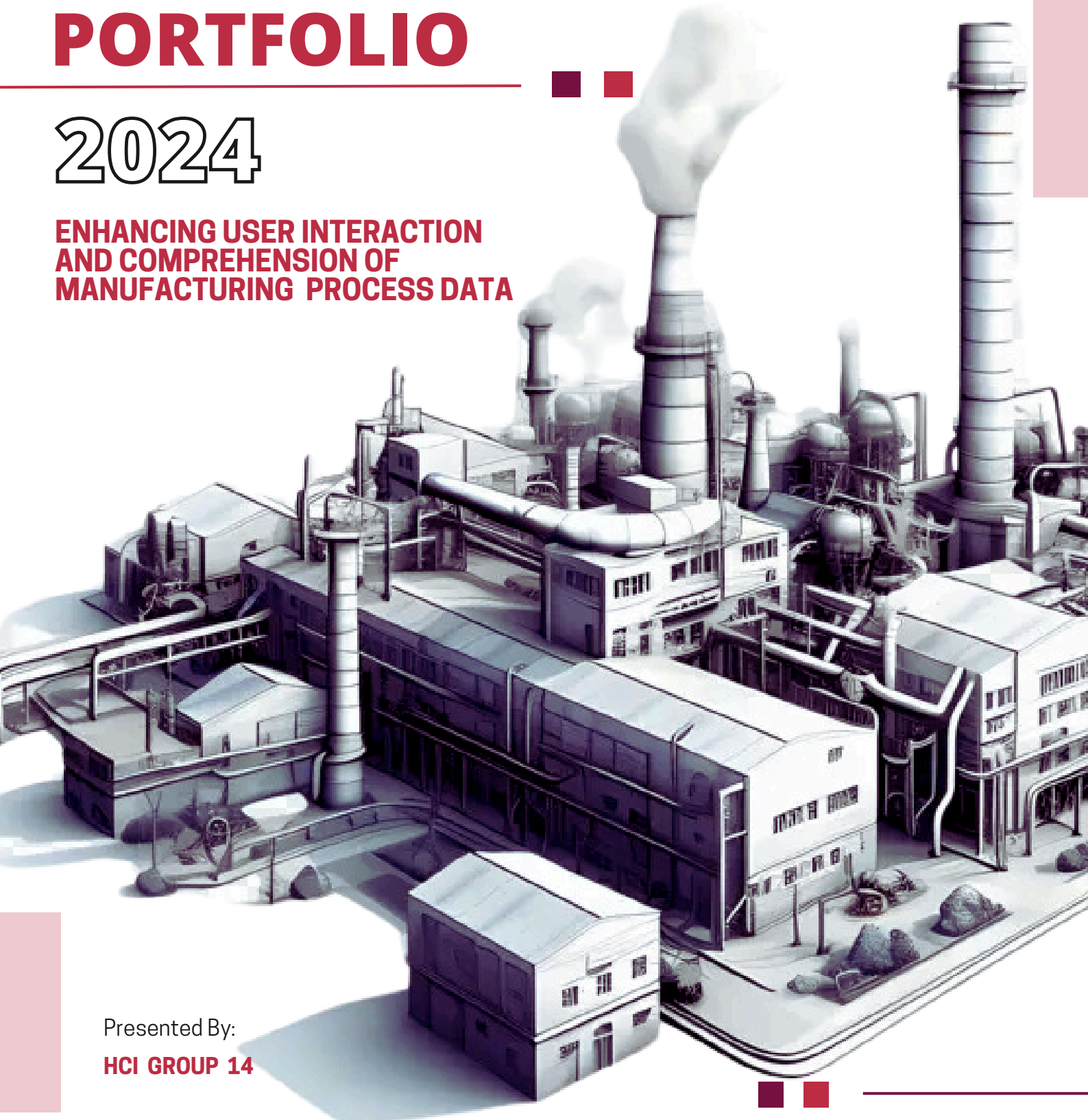
IRISH MANUFACTURING RESEARCH

HCI DESIGN CHALLENGE

PORTFOLIO

2024

ENHANCING USER INTERACTION AND COMPREHENSION OF MANUFACTURING PROCESS DATA



Presented By:

HCI GROUP 14

GROUP 14 : KISHORE SHAW , Yang Xi, Chenying Tian, Hongyi Shang, Huaibo Zhang

Project Partner: Dr Fahim Salim, Senior researcher, IMR

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MEET **OUR PARTNER**

IRISH MANUFACTURING RESEARCH

Irish Manufacturing Research (IMR) is a government-sponsored initiative dedicated to supporting Ireland's manufacturing sector in embracing cutting-edge technologies. With its motto, "demystify, derisk, and deliver," IMR collaborates directly with industry partners, ensuring the seamless integration of emerging technologies while mitigating associated risks.

Through its commitment to demystifying complex technologies, reducing risks, and delivering tangible results, IMR plays a pivotal role in driving sustained growth and innovation within the manufacturing industry.

“Dr. Fahim Salim, Senior Industrial Analytics Researcher at Irish Manufacturing Research (IMR), is an Applied Computer Science researcher with a keen interest in Human Centered AI.
Specializing in this field, his research involves integrating multimodal signals such as video streams and sensors with machine learning techniques and human media interaction to deliver context-aware,
engaging, and interactive information.
Dr. Salim's expertise significantly enhances IMR's research
process, ensuring the development of innovative and user-centric solutions tailored specifically for the manufacturing sector.”

Dr Fahim Salim

ABOUT ME

Hey there! I'm Kishore Shaw, and I'm thrilled to share a bit about my journey with you. I'm currently diving into the world of Human-Computer Interaction (HCI) at University College Dublin, where I'm exploring how we can make technology more intuitive and user-friendly. My path to HCI started with a strong foundation in Computer Science, which I built during my time at SRM Easwari Engineering College and through some exciting professional experiences.

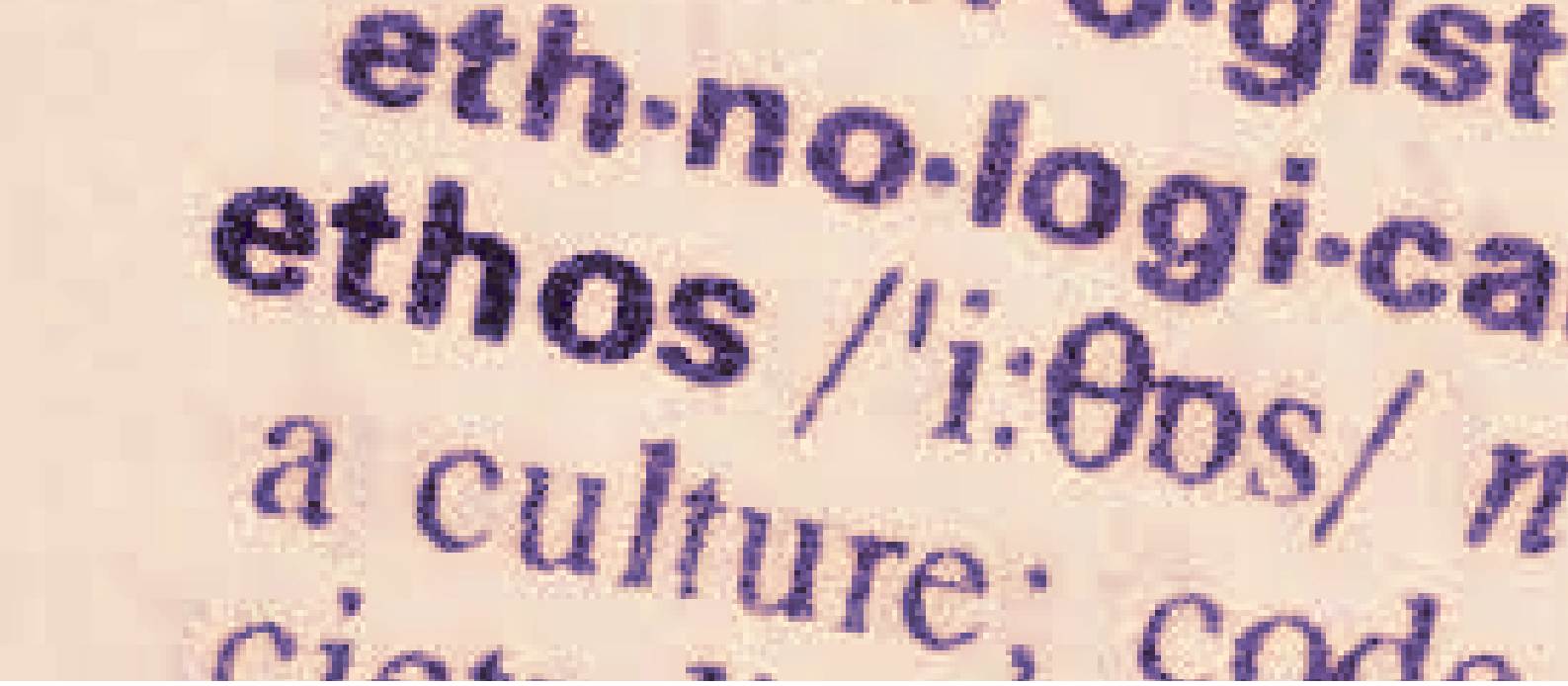
KISHORE SHAW

K Shaw

Before jumping into Masters, I spent time at Accenture, where I worked as a Custom Software Engineering Associate. My days were filled with crafting efficient Front-end solutions in JavaScript and Angular, but I also had a blast bringing designs to life on the front-end designing. I've always believed that technology should feel seamless and enjoyable to use, and that's something I strived to achieve in every project—whether it was optimizing data processes or ensuring that web pages looked perfect on any device.

In our team project, I had the chance to really dig into research and prototyping, blending my technical skills with my passion for creating great user experiences. What you'll find in this portfolio is documentation and a reflection of that journey—how we tackled challenges, celebrated wins, and most importantly, learned a ton along the way.

I hope as you go through this portfolio, you'll get a sense of not just what we built, but the enthusiasm and creativity that went into it. This project has been a fun and enriching part of my HCI adventure, and I'm excited to share it with you!



Collaboration, Integrity, and Continuous Improvement

My personal ethos is rooted in the principles of collaboration, integrity, and a commitment to continuous improvement. I believe that the best outcomes are achieved through open communication and teamwork, where diverse perspectives are valued and integrated into the solution. The bridge represents collaboration: connection bringing people together, integrity: showing the structure holding together, continuous improvement represented by the river shows the moving forward motion and going with the flow.

Empowering Users through Intuitive Design and Technological Innovation

My ethos for the project coursed to align with the design challenge and was centered on the belief that the most effective technological solutions are those that empower users by being both intuitive and innovative

MEET THE **TEAM**

People I travelled with during the project

YANG XI

New Media Editor

Yang Xi, a proficient new media editor, joins the team with six months of experience. With expertise in content creation, social media management, and multimedia production.
Yang Xi excels in captivating audiences through creative content strategies and is good at designing.

HUAIBO ZHANG

Product Manager

Huaibo Zhang, a seasoned Product Manager, possesses a deep understanding of project management, user research, and product development. Skilled in Agile methodologies, user story creation, and market research.

CHENYING TIAN

Product Manager

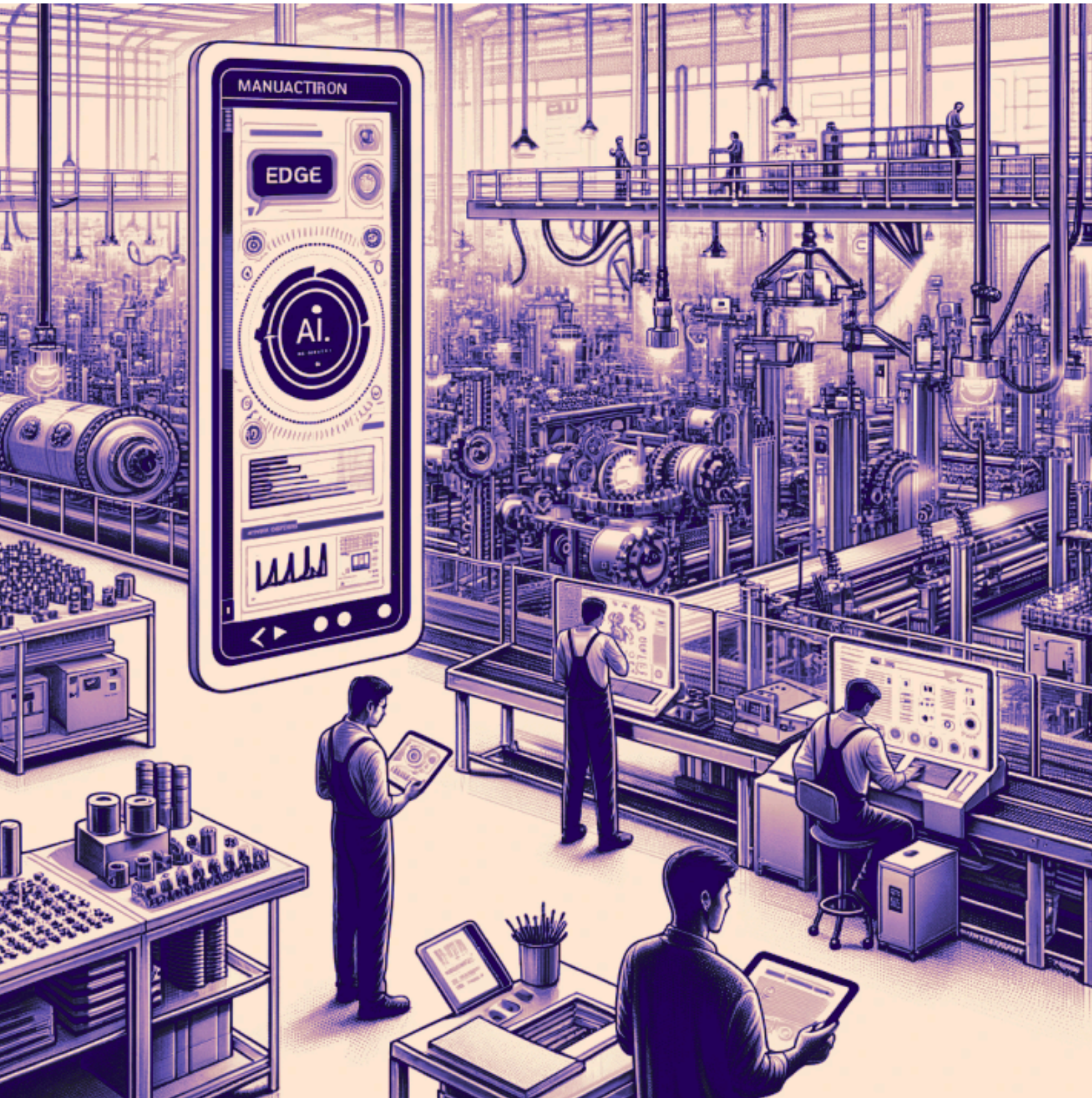
Chenying Tian, originating from China, contributes her expertise as a product manager with six months of industry experience.
Her passion lies in the intersection of UI/UX design, user research, and project management.

HONGYI SHANG

Software Engineer

Hongyi Shang, hailing from China, brings one year of software engineering experience and has a keen interest in software development and UI/UX design.
He excels in merging technology seamlessly with user experience, delivering impactful solutions tailored to user needs.

INTRODUCING
DESIGN CHALLENGE



ABOUT GIVEN CHALLENGE

Our Human-Computer Interaction (HCI) Design project, in collaboration with Irish Manufacturing Research (IMR), focuses on enhancing the comprehension of complex manufacturing process data through the innovative use of Large Language Models (LLMs). This project aims to design user-centric interaction mechanisms that support knowledge sharing and improve the efficiency and effectiveness of factory personnel. As manufacturing processes become increasingly knowledge-intensive, the capacity to train and support new staff is strained, especially within maintenance teams.

This challenge presents an opportunity to make a tangible impact on the manufacturing industry by leveraging state-of-the-art natural language processing to enhance operational efficiency and competitive advantage.

> “How might we design for interaction with LLMs, so as to enhance comprehension of manufacturing process data for personnel, including maintenance staff.”

REVISED CHALLENGE

The design challenge initially provided focus on designing for interaction with LLM's as to enhance usage of manufacturing process data in work environment. We, as a team approached our project partner to get a briefing about the design challenge linking how it contributes to our project and IMR.

We got motivation on how to address and start with the challenge. Mr. Fahim arranged another meeting with his colleague Mr. Daugirdas Stirbys, who gave the design challenge direction towards a machine developed by IMR to research and enhance machine user Interactivity and experience for operators and new users.

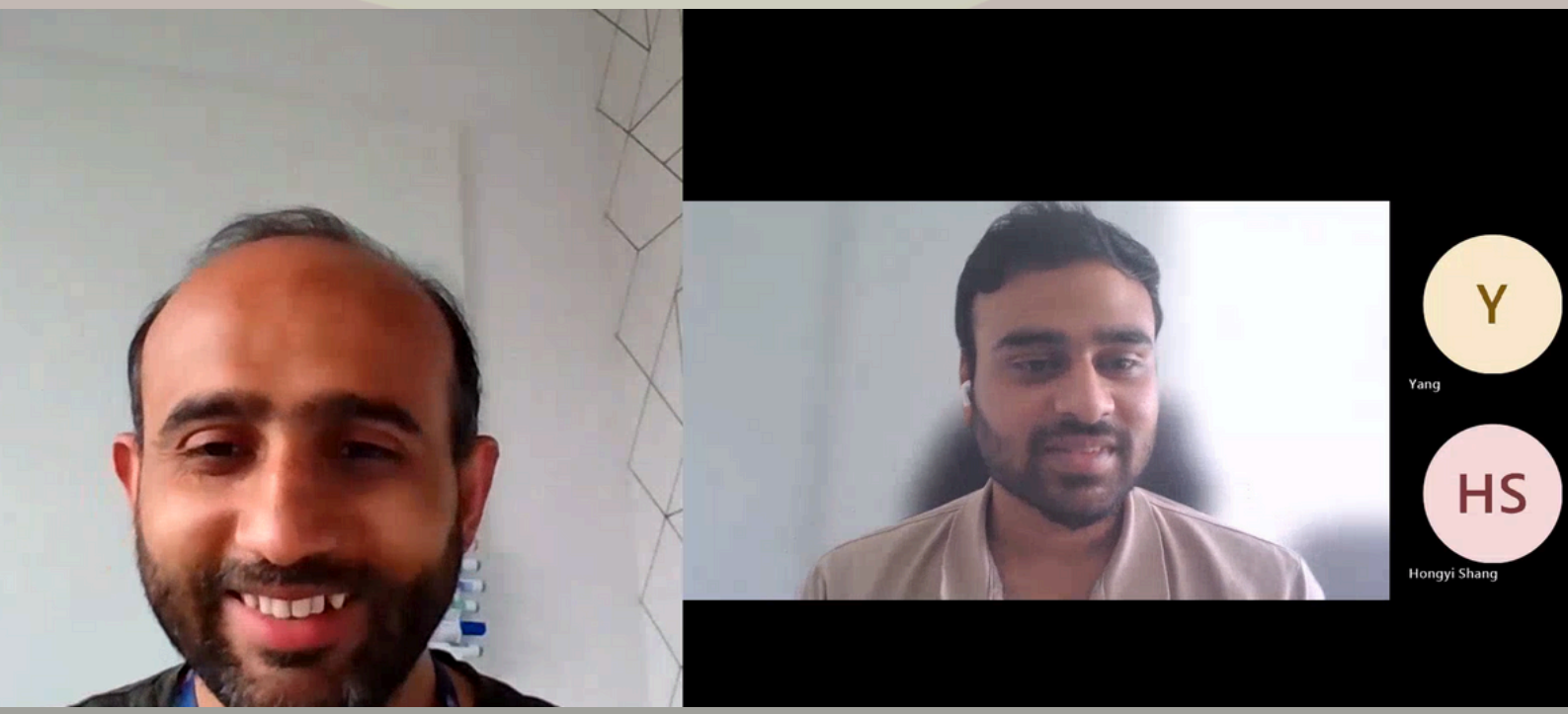


Image featuring myself and our project partner Mr. Fahim discussing about our project design challenge through virtual call.

REVISED CHALLENGE INTRODUCTION

IMR is a government aided research based company working towards industrialisation 4.0. They have developed a simulation platform for showcasing different scheduling algorithms which can be used in manufacturing settings. It is a physical machine which has different components funtioning on a whole to showcase the simulation of machines and processes taking place in industry. Our initial challenge was to how might we design for interaction with LLMs but after multiple meets with our project partner we set our course on researching on the components of the machine named mach 4.0 to enhance user interactivity and comprehension of data to make the machine more self explanatory.

I started preparing with related literatures given with our challenge, relevant topics and doubts to come up during the meeting we had at the start of the project. I conversed with both Mr. Fahim and Mr. Daug through zoom video call confidently and gained a lot of insights which I believe gave my team members a direction and clear problem statement. Although it was hard to involve in the conversation all alone with project partners, I managed to clarify most of my doubts and explain it to my team.

REFLECTIO

PERSONAL

LITERATURE **REVIEW** **&** KEY INSIGHTS

IRISH MANUFACTURING SECTOR

Description

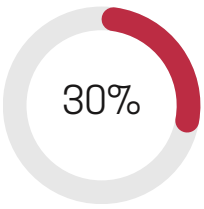
Ireland's manufacturing industry faces many challenges in adopting AI and other advanced technologies. Understanding these challenges and their impact on manufacturing is crucial to providing effective solutions to ensure that Ireland's manufacturing sector can maintain and expand its competitiveness.

Key Contributor

Manufacturing is a pillar of Ireland's national economy.

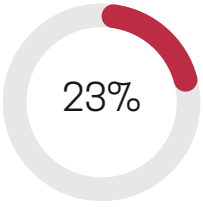
Main Industries:

Pharmaceuticals,chemicals, electronics, and food processing (Ibec, 2023).



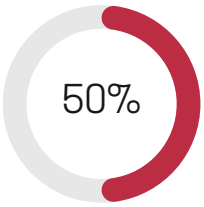
GDP & EMPLOYMENT

Accounts for over 30% of GDP and 20% of jobs.



AI ADOPTION

In 2021, 23% of companies in Ireland used AI, the highest in the EU (Eurostat, 2021).



STAGES

Despite the high usage of AI, Domhnall Carroll, CEO of Digital Manufacturing Ireland, believes that Ireland's manufacturing industry is still in the early stages of adopting AI technology (The Irish Times, 2023).

LITERATURE **REVIEW**

The adoption of artificial intelligence (AI) in Ireland's manufacturing sector has shown significant growth, with 23% of companies employing AI technologies as of 2021, the highest rate in the European Union (Eurostat, 2021). This widespread adoption highlights Ireland's proactive approach to integrating AI into manufacturing processes.

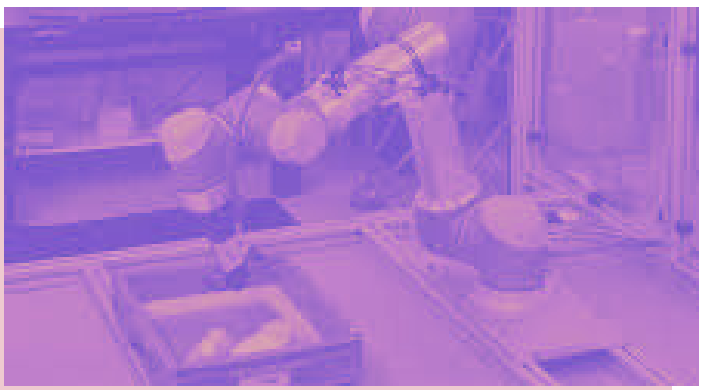
However, despite this progress, experts like Domhnall Carroll, CEO of Digital Manufacturing Ireland, argue that the industry is still in its early stages of fully embracing AI (The Irish Times, 2023). This early stage is characterized by fragmented implementations and a lack of cohesive strategy across the sector, indicating that while interest in AI is high, there is still a long way to go in terms of full-scale, effective adoption.

THIS LITERATURE REVIEW AIMS TO

EXPLORE	Explore the current status of Ireland's manufacturing industry and the application of AI and other advanced technologies.
RESEARCH	Summarize ongoing research and technological developments in the industry.
ANALYSE	Analyze the advantages and disadvantages of these technologies.
CONCLUDE	Conclude with future research directions and their impact on Ireland's manufacturing industry.

INTEGRATION WITH ADVANCED TECHNOLOGIES

Integrating AI with other advanced technologies such as digital twins and machine learning (ML) models is essential for realizing the full benefits of Industry 4.0. Digital twins, which are virtual replicas of physical systems, provide real-time insights into manufacturing processes, enabling more efficient monitoring and control. The success of these technologies heavily depends on effective Human-Computer Interaction (HCI) design, which ensures that the interfaces are intuitive and user-friendly. According to Georgakopoulos et al. (2023), digital twins and dependency-aware ML models can significantly enhance production efficiency and product quality when integrated with well-designed HCI interfaces. Similarly, Xu and Dainoff (2023) highlight that the integration of human-centered AI with HCI design can improve the usability and acceptance of AI systems across various manufacturing applications.



HCI FOR MANUFACTURING

CHALLENGES AND OPPORTUNITIES

The implementation of AI in manufacturing is not without its challenges. Key issues such as data privacy concerns, system security vulnerabilities, the technical complexity of AI systems, and the high costs associated with implementation pose significant barriers. These challenges are exacerbated by a lack of understanding among many industry stakeholders about the potential benefits and applications of AI. Addressing these barriers is crucial for the industry to unlock the full potential of AI. For example, Whelan (2024) suggests that strengthening collaboration among enterprises and enhancing knowledge sharing are vital steps to overcome these obstacles. The Irish Centre for Business Excellence has been actively promoting such collaborations to facilitate the widespread adoption of AI and other advanced technologies across the sector (The Irish Times, 2023).

THE ROLE OF HCI IN ADDRESSING MANUFACTURING CHALLENGES

HCI design plays a critical role in addressing the challenges faced by the manufacturing industry, such as low efficiency, inconsistent product quality, and high energy consumption. By focusing on user-centered interfaces, HCI design can optimize these processes, leading to improved overall efficiency. This aligns with the goals of Irish Manufacturing Research (IMR) to enhance efficiency and reliability in manufacturing processes. Tscheligi (2007) emphasizes that HCI is essential for solving societal and industrial challenges by enhancing user-technology interactions. This perspective is particularly relevant as the manufacturing industry increasingly relies on advanced technologies that require sophisticated interaction mechanisms to be effective.

ADDITIONAL **RESEARCH**

USER-CENTERED DESIGN IN HMI

Kamizi (2021) emphasized the importance of user-centered design in developing HMIs that are both intuitive and efficient. This research guided our approach to interface design, ensuring that the HMI not only meets technical requirements but also aligns with the cognitive and operational needs of the users.

HMI INDUSTRIAL APPLICATION

From the researches of Kumar and Lee (2022), Kamizi (2021), Adamčerveň (2023), user experience plays a major role in factories using interactive GUI HMI's. As it is still a developing sector of adopting AI and tools in factories, studies are undertaken to explore more into integration of such technologies to machines. According to Souza et al. (2014), Human machine interaction is also a factor along with building a simulation platform for factories to enhance dynamics of production.

INTEGRATION OF SIMULATION TECHNIQUES IN HMI AND UI DESIGN

The combination of simulation-based optimization techniques, such as Monte Carlo and discrete event simulations, directly influenced the design of the HMI. By understanding the potential bottlenecks and optimizing workflows through these simulations, we were able to design an HMI that provides operators with real-time feedback, thereby enhancing decision-making and reducing downtime (Okuyelu et al., 2024). This research is close to our design challenge but of to build a whole simulation technique. Our existing machine uses greybox scheduling algorithm and HMI, UI are still in reiteration phase.

RELATED WORKS

In our project, the integration of simulation-based optimization and Human-Machine Interface (HMI) design principles played a crucial role. Okuyelu et al. (2024) emphasize the importance of simulation technologies such as Monte Carlo simulations and discrete event simulations in optimizing manufacturing processes, which directly informed our approach to enhancing the efficiency of the Mach 4.0 platform which uses grey-box scheduling algorithm. Additionally, Kamizi (2021) highlights the critical role of UI/UX in industrial applications, particularly in creating interfaces that minimize user error and improve productivity. These insights were pivotal in designing the intuitive and user-friendly UI for Mach 4.0, ensuring that it met the operational needs of users while maintaining high standards of efficiency. By combining simulation techniques with thoughtful HMI design, our project aimed to address both the technical and user-centric aspects of industrial platform development, leading to a robust and effective solution of designing HMI and computer UI with keeping in mind the studies acknowledged like visualisation, cognitive load, modalities and etc.

* Related works have been updated to the latest finds matching to Mach 4.0 functionalities

SUMMARY

Looking ahead, the future of AI in Ireland's manufacturing industry will depend on addressing the current challenges and capitalizing on emerging opportunities. Strengthening partnerships between industry players, improving AI literacy, and developing robust strategies for AI adoption will be crucial. Additionally, there is a need to explore further relevant HCI literature to gain deeper insights into practical applications of AI in manufacturing. For instance, the work by Baldauf et al. (2021) on co-designing mobile and wearable monitoring systems with manufacturing staff provides valuable insights into how AI and HCI can be integrated effectively in the manufacturing context. As the industry continues to evolve, ongoing research and technological developments will play a critical role in shaping the landscape of AI adoption in Ireland's manufacturing sector, ensuring that it remains competitive on a global scale.

KEY INSIGHTS

INTRO

"This report explores the advancements in user interface design and interaction with Large Language Models (LLMs) in the manufacturing industry. By examining various aspects such as data visualization, remote operation UI, and human-machine collaboration, we aim to highlight the key insights and recommendations for enhancing user experience and system efficiency."

01. UI Design and Data Visualization:

Effective data visualization methods are essential for user comprehension and analysis, akin to explainable AI (Dudley and Kristensson, 2018). This ensures users can make informed decisions based on clear and concise data presentations.

02. Remote Operation UI

Emphasis on usability testing, clear control states, and augmented reality for improved situational awareness in autonomous vehicle operations (Tener and Lanir, 2023). Such technologies help operators maintain better control and awareness of their surroundings.

03. Color in UI Design

The impact of colour choices on user experience is significant, with appropriate colours enhancing usability and poor choices causing confusion and strain. (Meier,1988)

04. Collaborative Manufacturing:

Recommendations include enhancing situational awareness, improving diagnostics, and integrating multi-sensor information for better operator control in collaborative environments.
(Marvel et al.,2020)

KEY INSIGHTS 02

ABSTRACT

The manufacturing industry is rapidly evolving with the development of Industry 4.0 and the Industrial Internet of Things (IIoT). This review explores the current state and challenges of user interface design and Large Language Model (LLM) interaction in manufacturing, with a focus on enhancing user understanding of manufacturing process data and making systems more intuitive and clear through improved UI design.

05. Leveraging LLM's for Knowledge Sharing

Customizing LLMs for manufacturing involves using visual semantic control and real-time feedback loops to enhance user interaction and improve system performance, and balancing AI with human interaction to enhance task planning and human-robot interaction.
(Kernan et al.,2024)

06. Haptic Feedback

Proposals for using haptic channels to reduce information overload, suggesting haptic controllers for data playback and anomaly feedback in high-precision tasks.（Di Martino and Vitale,2020)

07. Human-Machine Collaboration

Advocacy for anthropocentric design, integrating visual semantic control, real-time feedback, user-friendly interfaces, and cobots to improve efficiency and safety, bridging human instructions and robotic execution.
(Fan et al.,2024)

08. Human-Machine Interaction

The importance of human-centred design, effective training, and situational awareness, supporting LLM-powered systems that enhance user experience, decision-making, and seamless human-machine collaboration in Industry 4.0.
(Ionescu,2021)

SUMMARY

In summary, the integration of advanced UI design principles and LLMs in manufacturing holds significant potential for improving situational awareness, user interaction, and overall system performance. Continued research and development in this field will further enhance the capabilities of industrial systems and contribute to the evolution of Industry 4.0.

ADDITIONAL KEY INSIGHTS

01

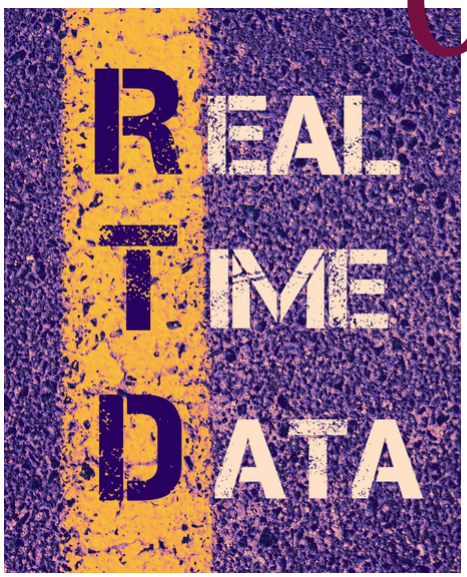
USER-CENTERED DESIGN IN INDUSTRIAL INTERFACES

Kamizi (2021) emphasizes the necessity of user-centered design in Human-Machine Interfaces (HMI) for industrial applications, pointing out that intuitive and responsive interfaces can significantly reduce user error and improve productivity. This insight led us to prioritize a user-friendly UI in our design, ensuring that the Mach 4.0 platform was accessible and easy to navigate, even for users with varying levels of technical expertise. The adoption of Bento grids in our UI design was a direct result of this focus, providing a clear and organized layout that enhances user interaction.

02

INTEGRATION OF REAL-TIME DATA WITH SIMULATION FOR DYNAMIC DECISION-MAKING:

Okuyelu et al. (2024) discuss the benefits of integrating real-time data with simulation models, which allows for dynamic decision-making in complex manufacturing environments. Inspired by this, we implemented design inspirations for real-time data integration in the Mach 4.0 platform, allowing users to monitor and adjust processes in real-time, ensuring optimal performance and minimizing downtime.



03

IMPACT OF HMI ON OPERATIONAL EFFICIENCY

The combined insights from the research emphasized the critical role of HMI in not just controlling machines but also in enhancing overall operational efficiency. By designing an HMI that integrates real-time data, predictive analytics, and user-friendly interfaces, we were able to create a system that significantly reduces operator error and improves process reliability

REFLECTION

In the development of our project, the literature review and key insights played a fundamental role in guiding my contributions to the final design.

As I delved into the literature on keywords such as simulation platform, manufacturing process, Human Machine Interaction, user experience (UX), process data, and predictive analytics, I identified key themes that resonated with the goals of our project. I took these themes—such as the importance of clear communication, real-time data visualization, and the integration of AI and ensured they were embedded in the design of our platform. For instance, the idea of using Bento grids for a customizable interface was directly influenced by research emphasizing the need for flexibility and user adaptability in complex systems and implementing LLM features like chatbot, forecasts section. These are one of many factors influencing the design choices.

The collective effort of our team was crucial in bringing these ideas to life. My teammates contributed their expertise in areas like AI driven tools, data processing, and Manufacturing sector, which helped refine and implement the concepts I proposed. Their input was invaluable, particularly in ensuring that the AI-driven features and the HMI structure were not only innovative but also practical and aligned with user needs. The collaboration within our team allowed us to create a final design that was both technically sound and user-friendly.

Reflecting on this process, I realize how critical the integration of research and collaboration was to the success of our project. The literature provided a strong foundation, but it was the iterative application of these insights, combined with the diverse perspectives within our team, that truly shaped the final product. This experience has reinforced my belief in the importance of grounding design in solid research while remaining flexible and open to feedback throughout the development process. Moving forward, I am more confident in my ability to balance innovative design with practical usability, ensuring that future projects are both cutting-edge and user-centric.
4o

DESIGN **PROCESS**

Empathize

Objective:
Understand the needs, challenges, and preferences of the users to build a more user-friendly interface.

Actions:
User Interviews; Observation; Surveys; Persona Development

Define

Objective:
Clearly articulate the problems and goals based on the insights gathered during the empathize phase.

Actions:
Problem Statement; User Needs; Success Metrics

Ideate

Objective:
Generate a wide range of ideas and solutions to address the defined problems.

Actions:
Brainstorming Sessions; Mind Mapping; Sketching and Storyboarding; SWOT Analysis

Prototype

Objective:
Build low-fidelity and high-fidelity prototypes of the proposed solutions.

Actions:
Wireframes; Mockups; Scenario Testing

Test

Objective:
Evaluate the prototypes with real users to gather feedback and refine the designs.

Actions:
Testing; Feedback Collection; Iterative Refinement; A/B Testing

Implement

Objective:
Finalize the design and deploy the improved user interface to the platform.

Actions:
Final Design; Development; Training; Launch and Monitor; Continuous Improvement

PROCESS DIAGRAM

I contributed in the creation of this process diagram completely. With discussion within our group, we as a team proposed the design process steps to undertake.

Interviews; Observation; Surveys; Persona Development

1 EMPATHIZE

Brainstorming Sessions; Mind Mapping; Sketching and Storyboarding; SWOT Analysis

3 IDEATE

2 DEFINE

Problem Statement; User Needs; Success Metrics

Testing; Feedback Collection; Iterative Refinement; A/B Testing

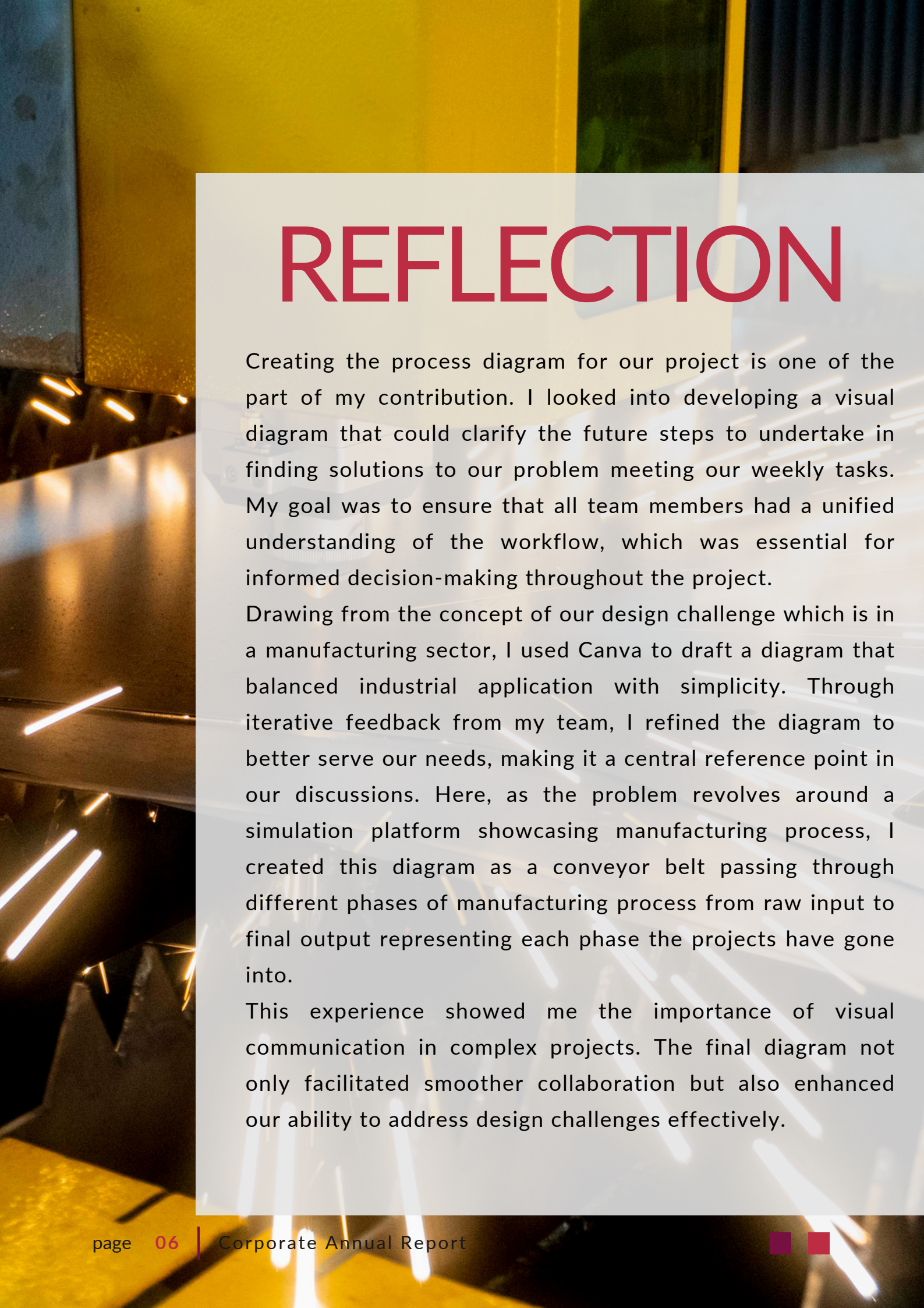
TEST 5

4 PROTOTYPE

Wireframes; Mockups; Scenario Testing

6 IMPLEMENT

Final Design; Development; Training; Launch and Monitor; Continuous Improvement



REFLECTION

Creating the process diagram for our project is one of the part of my contribution. I looked into developing a visual diagram that could clarify the future steps to undertake in finding solutions to our problem meeting our weekly tasks. My goal was to ensure that all team members had a unified understanding of the workflow, which was essential for informed decision-making throughout the project.

Drawing from the concept of our design challenge which is in a manufacturing sector, I used Canva to draft a diagram that balanced industrial application with simplicity. Through iterative feedback from my team, I refined the diagram to better serve our needs, making it a central reference point in our discussions. Here, as the problem revolves around a simulation platform showcasing manufacturing process, I created this diagram as a conveyor belt passing through different phases of manufacturing process from raw input to final output representing each phase the projects have gone into.

This experience showed me the importance of visual communication in complex projects. The final diagram not only facilitated smoother collaboration but also enhanced our ability to address design challenges effectively.

INTERVIEW GUIDE AND JOURNEY MAP

15

INTERVIEW **GUIDE**

We are interested in better understanding the nature of data collection, sharing, and interpretation in machining 4.0.

The goal of this interview is to gain insights into the current functionality of the Mach 4.0 platform and identify areas where interaction can be enhanced by redesigning or by using advanced technologies such as Large Language Models (LLMs).

Your input will be valuable in shaping the improvements we plan to implement.

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02 BACKGROUND INFORMATION

03 UNDERSTANDING THE PLATFORM

04 IDENTIFYING PAIN POINTS AND EXPLORING IMPROVEMENTS

05 TECHNICAL CONSIDERATIONS

06 ACKNOWLEDGMENTS

INTERVIEW **GUIDE**

Stakeholder's Role

- Could you please describe your role in the development or involvement with the Mach 4.0 platform if you were involved?
- Have you had any involvement with the Mach 4.0 platform or similar projects? If so, could you elaborate on your contributions and experiences with it?

Tasks and Usage

- For which tasks do you use CNC machinery, and why is this the best approach?

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INTERVIEW **GUIDE**

Platform Functionality

- Can you provide an overview of the main functionalities of the Mach 4.0 platform?
- How will Mach 4.0 contribute to the manufacturing sector as in what problems does it solve?

Current User Interaction

- How do users or stakeholders currently interact with the platform? Can you describe a typical user interaction scenario?
- Could you explain how you interact with the platform?
- Whom do you collaborate with regarding your use of CNC machinery? Of whom is this team composed? How often do you interact, how, and where?
- Have you received any feedback from users regarding their experience with the platform? If so, what are the common good points or criticism?
- Can you give us some insight into the role of data in your work with Mach 4.0? What data do you gather, receive, and analyze? For which purposes?

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INTERVIEW **GUIDE**

User Challenges

- What are the major challenges users face according to you when interacting with the Mach 4.0 platform?
- How do you think the interaction with the platform could be made more efficient?

Desired Features

- Are there any features or functionalities that you believe should be added to improve the platform?

LLM Integration

- What are your thoughts on integrating Large Language Models (LLMs) to assist with data interpretation and user interaction? How do you think it will benefit you?

Training and Support

- Could you walk us through the process of using the CNC machine interface during a typical operation? What key features do you interact with?
- What kinds of things can go wrong and how do you respond? Do you have or refer to operating manuals?
- ...

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INTERVIEW **GUIDE**

Technical Limitations

- What limitations do you foresee or see in implementing advanced features on the Mach 4.0 platform?

Data Integration

- How does the platform currently handle data integration and analytics? Are there any future goals to add new analytical features?

Security Concerns

- Are there any security concerns related to user interaction with the platform that we should be aware of?

Metrics and Success

- What are the metrics by which you measure success in your activities?

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INTERVIEW **GUIDE**

Thank you for speaking with us today.Your experiences help us understand the needs of CNC machine operators, allowing us to create a more intuitive and efficient platform with your input.

We will keep you updated on our progress. Thank you again for your time and valuable contribution.

01 INTRODUCTION

02 BACKGROUND INFORMATION

03 UNDERSTANDING THE PLATFORM

04 IDENTIFYING PAIN POINTS AND EXPLORING IMPROVEMENTS

05 TECHNICAL CONSIDERATIONS

06 ACKNOWLEDGMENTS

REFLECTION

ACKNOWLEDGING AND REFLECTING ON POTENTIAL BIASES IN INTERVIEWING

Machine operators, team members' diverse professional backgrounds may introduce preconceived assumptions and biases. To ensure objective data collection, it is crucial to identify and reflect on specific biases related to the understanding of machine operations and the Mach 4.0 platform, adopting a more open and exploratory approach in question design.

BUILDING RAPPORT WITH INTERVIEWEES

Establishing trust and interest with Mach 4.0 is key to getting detailed feedback.

- Building Trust: Asking specific and relevant questions shows a deep understanding of the operators' daily challenges, such as "For which tasks do you use Mach 4.0, and why is this the best approach?" This demonstrates interest and understanding of their work.
- Eliciting Interest: Showing genuine interest in their experiences by asking questions like "Whom do you collaborate with regarding your use of Mach 4.0 machinery? Who makes up this team? How often do you interact, how, and where?" These questions help understand their work environment and collaboration practices, making interviewees feel valued and more willing to share their thoughts and experiences.

OPTIMISING THE INTERVIEW ENVIRONMENT

To ensure interviewee feel comfortable and open during interviews, it is essential to:

- Familiar and Comfortable Setting: Conduct interviews in a familiar and convenient manner, such as through Zoom for remote communication, allowing them to freely discuss their interactions with the Mach 4.0 platform.
- Interview Timing: Choose times that cause the least disruption to their work schedule, ensuring they are relaxed and focused on the interview.

FUTURE INTERVIEW PLANS

- Continuous Improvement: Regularly integrate feedback from CNC operators to refine and adjust the interview guide, ensuring it remains relevant and focused on their specific needs and experiences.
- Align Questions with Research Focus: Ensure each question is directly related to understanding the practical use and challenges of the Mach 4.0 platform, closely aligning with the research objectives.
- Identify Success Metrics: Understand and incorporate the specific metrics operators use to measure success in their activities, such as efficiency, accuracy, or machine uptime, rather than assuming what is important to them.

As part of our project, I conducted in-depth interviews with two key stakeholders, Fahim Salim and Daugirdas Stirbys, who provided invaluable insights into the Mach 4.0 platform. My primary objective was to understand the current functionalities of the platform, the challenges users face, and potential areas for improvement, particularly in terms of user interaction and the integration of advanced technologies.

KEY INSIGHTS FROM MR. FAHIM INTERVIEW

Mr. Fahim, who is involved in supporting and presenting the Mach 4.0 platform, highlighted several user challenges, such as the complexity of operating the machine and the non-intuitive nature of its interface. He emphasized the need for the platform to be more self-explanatory to reduce reliance on manual guidance during demonstrations. This insight directly influenced our approach to redesigning the user interface, focusing on enhancing user autonomy and simplifying interaction processes.

KEY INSIGHTS FROM MR. DAUGIRDAS INTERVIEW

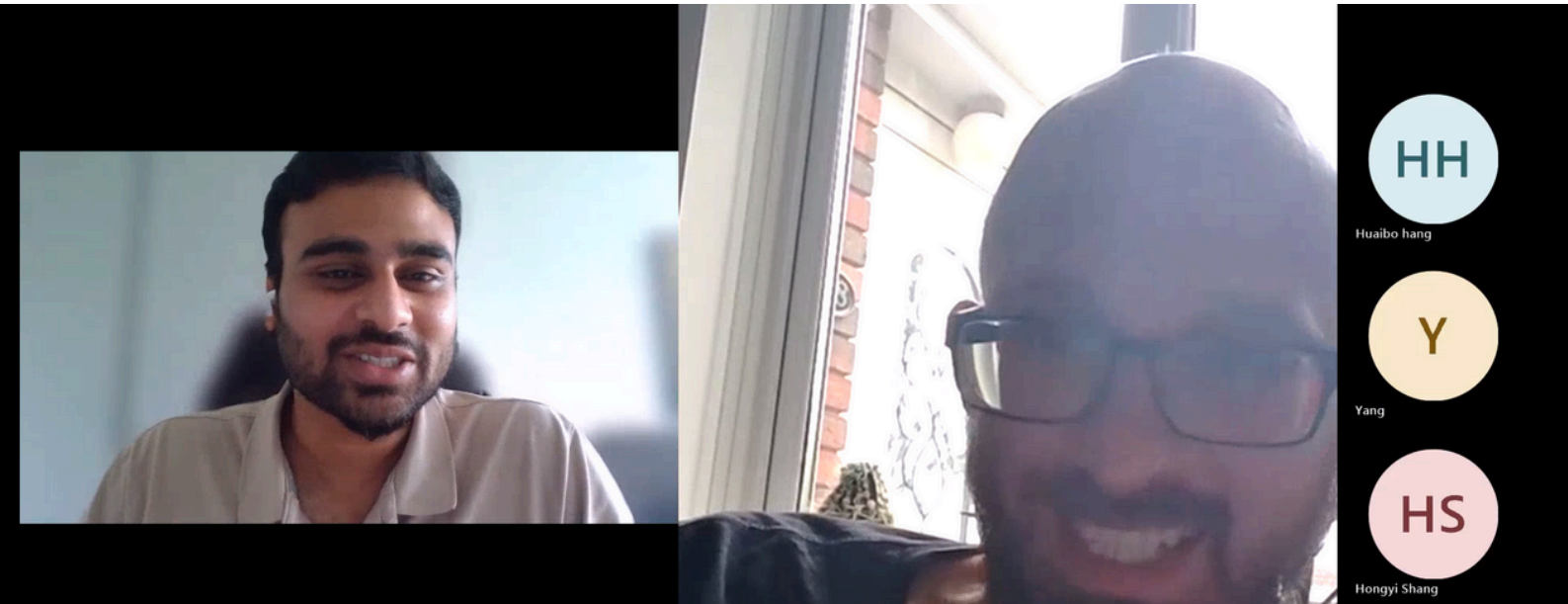
Mr. Daug, an engineer deeply involved in the mach 4.0 platform's development, provided a technical overview of the system's operations, including the integration of scheduling algorithms and the role of the Grey-box visualisation. He pointed out issues like the non-cyclic nature of the demo and the lack of an intuitive user interface, which requires significant manual intervention. His feedback underscored the importance of improving the UI to allow for more seamless and autonomous operation, which became a focal point in our design improvements.

SELF REFLECTION

These interviews were crucial in shaping our understanding of the user experience with the Mach 4.0 platform. Through my questioning, I was able to identify specific pain points that users encounter, which informed our design decisions.

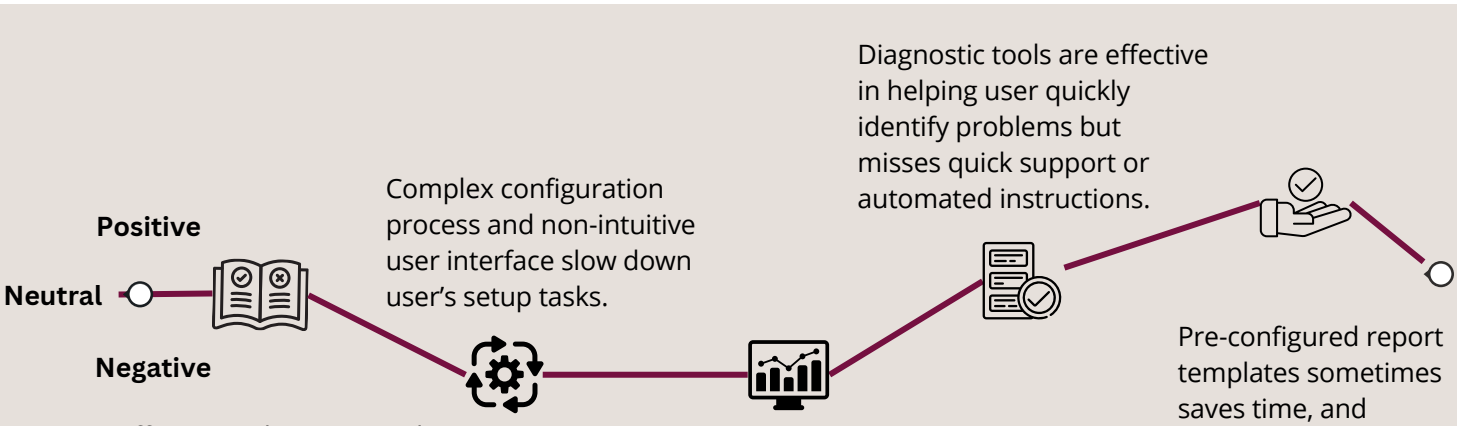
My ability to engage with both technical and non-technical aspects of the platform helped bridge the gap between user needs and the technical capabilities of the system, ultimately contributing to a more user-friendly design.
I learned a lot about how a structured interview is conducted and when semi-structured interview can be helpful other times, this experience will help me to undertake future researches with ease of understanding on how to conduct a interview with stakeholders.

Image featuring myself and Mr. Daugirdas Stirbys, who worked in the development of the mach 4.0 doing a interview to get key insights.



JOURNEY **MAPPING**

1 Preparation	2 Operation Setup	3 Monitoring	4 Issue Handling	5 Reporting
Customer Action • Gather Tools and Safety Gear • Login to Platform • Get last known information	**Customer Action** • Configure Machines • Check Machine Readiness • Ensure all safety guards are • in place	**Customer Action** • Monitor Machine Status • Performance Tracking • Executes scheduled tasks and processes.	**Customer Action** • Diagnoses issues or malfunctions in machines. • Resolves technical problems • Contacts support for unresolved issues.	**Customer Action** • Ensure all tools and materials are accounted for • Document Shift Activities (Includes performance and issue reports)
Touchpoints • User login interface • Dashboard	**Touchpoints** • Machine configuration interface • Readiness checklist	**Touchpoints** • Real-time dashboard • Status indicators (e.g., lights, HMI)	**Touchpoints** • Error alerts • Troubleshooting interface	**Touchpoints** • Reporting notes, interface • Communication platforms (email)
Emotions Neutral, frustation	**Emotions** Negative, confusion	**Emotions** Negative, difficult	**Emotions** Neutral, helpless	**Emotions** Positive, happy
Pain Points • Initial setup time can be lengthy • Difficulty in locating necessary documentation quickly.	**Pain Points** • Complex configuration process. • Time-consuming readiness checks.	**Pain Points** • Overload of information, hard to prioritize important data • Delays in receiving real-time updates.	**Pain Points** • Difficulty in diagnosing issues fastly • Lack of clear, actionable instruction	**Pain Points** • Time-consuming documentation process. • Inconsistent handover communication.



I implemented this design for journey mapping where the contents are discussed and generated within our group

THEMATIC ANALYSIS PROCESS AND THEMES

THEMATIC APPROACH

01

Familiarization and Selection of Quotations

Familiarized with the transcript and highlighted roles of stakeholders involved in development or demonstration of Mach 4.0 platform.

02

Selection of Keywords

Coded sections on roles, functionalities, user interactions, demo feedback, data types, and suggestions for future improvements to categorize stakeholder insights systematically.

03

Coding

summarized the main points from each interview section, noting specific challenges and suggestions for the Mach 4.0 platform.

04

Theme Development

Developed themes on roles, system functionality, user experience, data handling, and future development plans based on coded data.

05

Review and Define Themes

Refined and clearly defined themes, ensuring they accurately reflected stakeholders' input on roles, functionality, user experience, data handling, and future development.

06

Write-up

Introduced thematic analysis purpose, provided detailed theme descriptions with quotes, created a narrative with data extracts, and summarized key findings and implications.

THEMATIC ANALYSIS **PROCESS**

THEME 01 Roles and Responsibilities

CODES

Technical Tasks, Integration Tasks, Presentation Tasks

STATEMENT

"I was an engineer; I was doing the pneumatics; I was doing the PLC programming; I was doing the firing off the sensors or robots all of that kind of stuff; robot programming I was involved in that;I was involved in integration...."

STATEMENT

"Support the people if you need any help； give visitors or industry partners a presentation, the description of the and have a discussion with them; as a researcher slash developer ...."

THEME 02 Application of the Mach 4.0 Platform in Manufacturing

CODES

Key Functionalities of Mach 4.0 Platform

STATEMENT

"The main functionalities of Mach 4.0 include demonstration of scheduling algorithms on a small scale simulated factory....."

CODES

Customer Engagement and Demonstration

STATEMENT

"Customers would be interested in 4.0 demo; The demo is actually demonstrated to the customers that are coming in on site in IMR;The demo device will also be transported to trade exhibitions to showcase IMR's capabilities and solutions...."

CODES

Complexity and Solution of Scheduling Problems

STATEMENT

"It's difficult to show the scheduling problem on paper really, and actually like this, this this is very surprising that was for me as well; It very clearly that the scheduling is actually complex problem; What problem is solving is demo the scheduling problem itself. ....."

Interviewees:

- Daugirdas Stirbys, Researcher at Irish Manufacturing Research. Irish Manufacturing Research
- Fahim Salim, Researcher in Human Centric Artificial Intelligence (AI). Irish Manufacturing Research

THEMATIC ANALYSIS **PROCESS**

THEME 03 User Interaction and Task Execution on Mach 4.0 Demo Platform

CODES

User Operation and Demonstration

CODES

Preparation Work and Task Scheduling

CODES

User Interface and Task Execution

STATEMENT

"We don't give to the customers to operate the machines themselves; They don't have some knowledge; it's either myself or one of my colleagues, comes with a demo; manually picked and placed inside of the tubes of the feeders."

STATEMENT

"Prepare the stage, prepare the factory; The machines need to be cleared, all the feeders need to be prepared. The robot position needs to be reset.; Start frontend application; The hardcoded number... to execute; The green box scheduler will extract..."

STATEMENT

"User interface shows what workpiece are in that machine at what time...; Simulate the failures on the factory floor... the green box recalculates the schedule and the schedule on the user interface will be changed.; 100-200 tasks... about 15 minutes... all consumed, executed machine stops... reset the machine; prepare for the next cycle."

THEME 04 Core Functionalities of the Mach 4.0 Platform

CODES

Automation and Reset Cycles

CODES

Data Integration and Polling

CODES

Schedule Optimization and Comparison

STATEMENT

"The current demo at the moment is not cyclic ... once it completes all the workpieces, it doesn't reset itself ... you have to manually pick and place the workpieces into the feeder tubes and reset everything manually."

STATEMENT

"Data integration ... the PLC that we're using currently supports only polling ... you might be losing the data of these short events and the short segments might be actually useful."

STATEMENT

"Can we ask the, let's say visitor, visiting companies to create a manual schedule for using the user interface ... gray box will create its own schedule, and they'll run the exact same thing."

STATEMENT

"What we wanted to do is when you've started and then you can leave with electrons for a whole day and nobody needs to stand around and be set and then feed the board pieces."

STATEMENT

"Additional plans to add analytic features to show the scheduling processes ... going to deploy AI models and running on our local server ... I think the plan is to actually integrate our locally run and train model instead of charging it."

STATEMENT

"It will compare that schedule, to your schedule and then you know, there are certain KPIs that your human would be expected to perform the worse than AI based algorithm."

THEME 05 Usability

CODES

understandability

CODES

Instruction

CODES

Information presentation

STATEMENT

"Demo requires some knowledge to be run ... there's always has to be a person with that ... we need the person that explains how the demo works, and is able to run the demo"

STATEMENT

" I can say that we can add training based user face like to show users or we was actually what the mission is doing, or a documentation of the mission and use of chatbots or use of HoloLens in different interaction with it."

STATEMENT

You should be able to look at an individual machine and see what tasks are scheduled or not work pieces are scheduled within that machine at certain times"

STATEMENT

"The drain box user interface is not very intuitive as well ... it's not ideal for the people who haven't seen the interface ... when you look at that intuitively you don't know what's happening "

STATEMENT

"Improving the current user interface. So it guides the person to run the demos themselves ... maybe step by step based user process, user interface with the process of how do you set up the demo and how do you run the demo "

STATEMENT

"How long that machine was actually performing the work, how long it was on loading stuff, how long it was in the maintenance stage"

KEYWORDS **COMPOSITION**

*

I contributed to thematics analysis by helping with generating keywords and selecting themes.
The keyword composition was structured and designed by myself with each colour representing different themes.

REFLECTION

In our project, I took an active role in the thematic analysis of the interviews conducted with our stakeholders, Fahim and Daug. This process was essential for taking out the rich qualitative data into meaningful themes that would guide our design decisions. My involvement began with a close reading of the interview transcripts which were recorded and shared by stakeholders, where I focused on identifying key phrases and concepts that were repeatedly emphasized by the interviewees.

Keywords and Coding

I initiated the analysis by selecting keywords and phrases that captured the core issues raised by Mr. Fahim and Mr. Daug. For example, from Fahim's interview, keywords like "complexity," "non-intuitive," and "manual intervention" stood out as critical issues regarding the usability of the Mach 4.0 platform. Similarly, in Daug's transcript, terms such as "scheduling problems," "user interface," and "automation limitations" were recurring themes that pointed to areas needing improvement.

Using these keywords, I applied an open coding approach to categorize the data. This process involved systematically labeling sections of the transcripts with these codes, which helped to organize the data into initial thematic groups. These groups were then reviewed and refined within our group members to ensure they accurately reflected the stakeholders' concerns and expectations.

Contribution on Themes

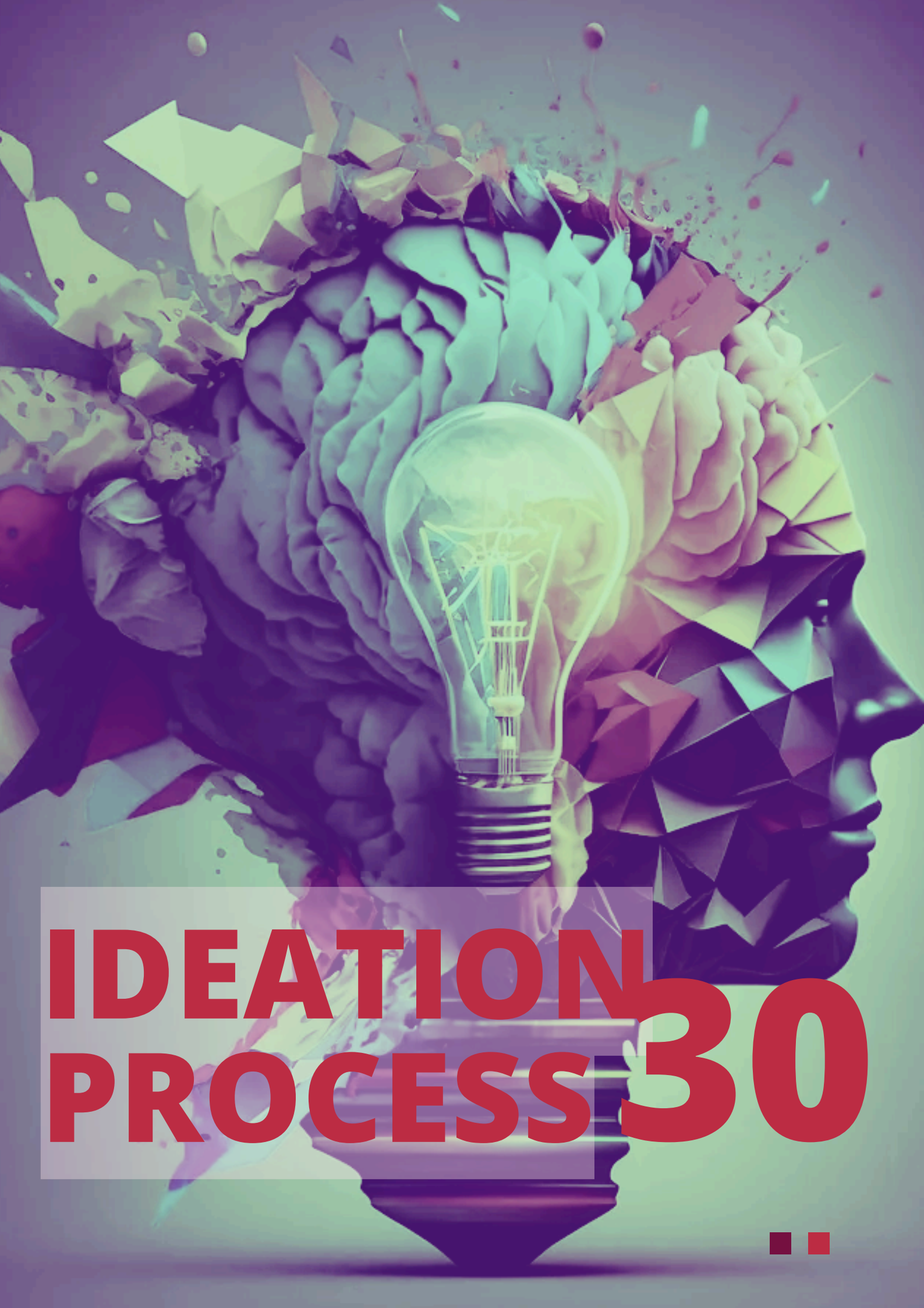
Building on the themes already identified during discussion, such as "Usability Challenges" and "Technological Integration," I ensured that the data from Fahim and Daug's interviews were effectively incorporated into these existing categories. For example, the theme of "Usability Challenges" was expanded to include the specific difficulties users face with the platform's interface and the need for more intuitive design, which was a significant insight from both interviews.

New Themes

In addition to reinforcing existing themes, I identified new themes based on the insights I personally gathered for designing HiFi. One such theme was "User Autonomy," which emerged from Fahim's emphasis on reducing the need for manual guidance during platform demonstrations. Another theme, "Real-Time Feedback and Automation," arose from Daug's discussion on the limitations of the current system's non-cyclic operations and the need for better automated processes.

These new themes pointed to the necessity of redesigning the platform to support more autonomous user interaction and enhancing real-time decision-making capabilities. They also highlighted the importance of integrating more advanced automation features to minimize manual intervention and improve the overall efficiency of the system.

My work in the thematic analysis not only contributed to a deeper understanding of the user needs but also directly influenced the direction of our design improvements. By identifying and categorizing these themes, I helped to ensure that our project remained aligned with the actual challenges and expectations of the stakeholders. This thematic analysis served as a crucial step in bridging the gap between user feedback and practical design solutions, ultimately enhancing the usability and functionality of the Mach 4.0 platform.



IDEATION PROCESS 30

IDEATION PROCESS
APPROACH

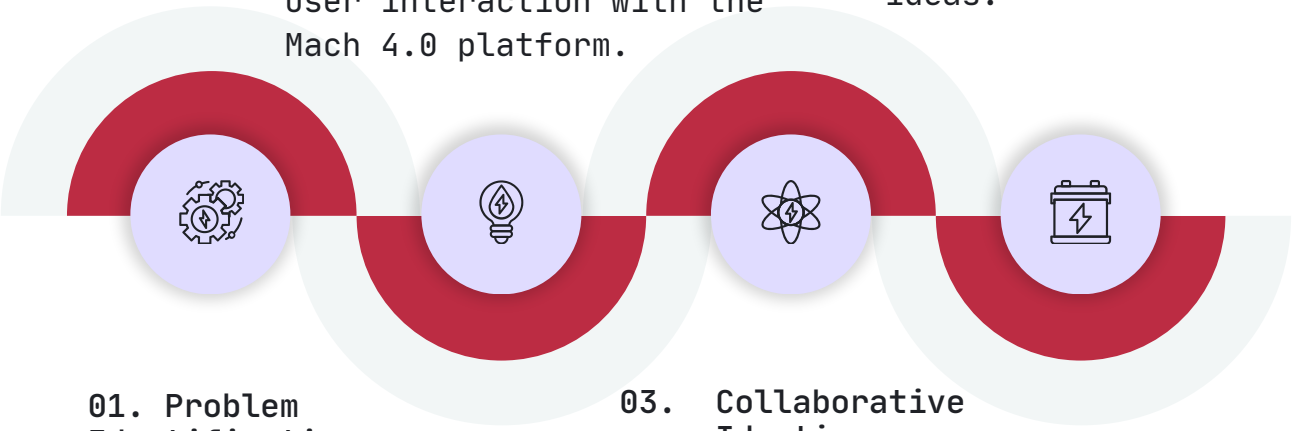
Our team followed a structured and collaborative approach to ideation, focusing on enhancing the interaction within the Mach 4.0 platform. The ideation process was designed to generate creative solutions, refine them through feedback, and align them with project goals.

02. Brainstorming Sessions

Generated a wide range of ideas and potential solutions for improving user interaction with the Mach 4.0 platform.

04. Concept Development

Developed initial, loose concept solutions based on the refined ideas.



01. Problem Identification and Understanding

Understood the needs and challenges associated with the Mach 4.0 platform.

03. Collaborative Ideation

Refined and expanded on initial ideas through collaborative discussion and feedback using Mural.

01
PROBLEM IDENTIFICATION **AND UNDERSTANDING**

01
PROBLEM STATEMENT

How might we guide the person to run the demos themselves?

02
PROBLEM STATEMENT

How might we show users the statute of each machine?

03
PROBLEM STATEMENT

How might we improve the current user interface to make it more intuitive?

04
PROBLEM STATEMENT

How might we provide effective training and support for users?

05
PROBLEM STATEMENT

How might we enhance the interactivity of the platform?

06
PROBLEM STATEMENT

How might we alert users when a machine malfunctions?

02
BRAINSTORMING **SESSIONS**

What Is The Problem?

How might we guide the person to run the demos themselves?

Solution ideas:

HUAIBO ZHANG

Develop an application that allows users to remotely control simple equipment operations.

HONGYI SHANG

Provide guides telling person how to run the demos, including step by step guides and chatbot.

YANG XI

Add a step-by-step guide feature to assist inexperienced users, helping them understand the operations while also showing what the machine is doing.

KISHORE SHAW

Demo virtual Tour when starting the Mach 4.0 platform in user interface monitor.

KISHORE SHAW

Augmented Reality guiding users to operate the machine through instructions using VR Headset.

What Is The Problem?

How might we enhance the interactivity of the platform?

Solution ideas:

CHENYING TIAN

Using virtual assistants to answer user questions or provide suggestions can significantly improve user experience and operational efficiency.

CHENYING TIAN

Ensure that the control buttons for each machine and device are clearly visible and easy to operate. In order to avoid accidental activation

HONGYI SHANG

Deploy ai models to chatbot, making it capable of analysing the data produced by the platform.

YANG XI

Use chatbots to help users answer questions, provide assistance, and enhance interactivity.

HUAIBO ZHANG

Develop an application that allows users to remotely control simple equipment operations.

YANG XI

Improve the existing interface design by adding icons and prominent colors to highlight key elements, making it easier to distinguish and understand.

KISHORE SHAW

Augmented Reality guiding users to operate the machine through instructions using VR Headset.

What Is The Problem?

How might we show users the status of each machine?

Solution ideas:

HUAIBO ZHANG

Develop a visual data dashboard that integrates multiple data sources to help management monitor production in real-time.

HUAIBO ZHANG

Create a tool to track and display production progress, helping management understand the production status.

HONGYI SHANG

Redesign the user interface to put important information together including status of machine and so on.

HONGYI SHANG

Deploy ai models to chatbot, making it capable of analysing the data produced by the platform.

YANG XI

Add a step-by-step guide feature to assist inexperienced users, helping them understand the operations while also showing what the machine is doing.

What Is The Problem?

How might we improve the current user interface to make it more intuitive?

Solution ideas:

CHENYING TIAN

Ensure that the control buttons for each machine and device are clearly visible and easy to operate. In order to avoid accidental activation

CHENYING TIAN

Place a small informational icon next to each interface element that needs to be explained.

YANG XI

Improve the existing interface design by adding icons and prominent colors to highlight key elements, making it easier to distinguish and understand.

What Is The Problem?

How might we provide effective training and support for users?

Solution ideas:

CHENYING TIAN

Using virtual assistants to answer user questions or provide suggestions can significantly improve user experience and operational efficiency.

YANG XI

Use chatbots to help users answer questions, provide assistance, and enhance interactivity.

What Is The Problem?

How might we alert users when a machine malfunctions?

Solution ideas:

HUAIBO ZHANG

Create a tool to track and display production progress, helping management understand the production status.

KISHORE SHAW

Notification center for user awareness and prompt timely actions through intelligent notifications.

REFLECTION

Ideas and Suggestions

Drawing from the insights gathered during the stakeholder interviews with Fahim and Daug, I identified key areas where the Mach 4.0 platform could be improved, particularly in terms of user experience and interface design. I proposed the idea of integrating an interactive and intuitive user interface that would simplify the operation of the platform, making it more accessible to users with varying technical backgrounds.
One of my primary suggestions was to implement a guided walkthrough feature within the interface. This feature would provide step-by-step instructions and real-time feedback to users as they navigate through different functions of the platform. The goal was to reduce the learning curve and minimize the need for external assistance during operations.

I believed that such a feature would empower users to operate the system more confidently and efficiently. Additionally, I advocated for the incorporation of visual analytics dashboards that would present complex data in a more digestible and insightful manner. By utilizing dynamic charts and graphs, users could easily monitor system performance, track scheduling efficiency, and identify potential bottlenecks. This idea stemmed from recognizing the importance of data-driven decision-making in optimizing industrial processes.

> **Strive for progress, not perfection.**

03
COLLABORATIVE **IDEATION**

Refined and expanded on initial ideas through collaborative discussion and feedback using Mural.

03
COLLABORATIVE **IDEATION**

Refined and expanded on initial ideas through collaborative discussion and feedback using Mural.

REFLECTION

In our project, I took an active role in the thematic analysis of the interviews conducted with our stakeholders, Fahim and Daug. This process was essential for taking out the rich qualitative data into meaningful themes that would guide our design decisions. My involvement began with a close reading of the interview transcripts which were recorded and shared by stakeholders, where I focused on identifying key phrases and concepts that were repeatedly emphasized by the interviewees.

Keywords and Coding

Throughout the ideation process, I actively engaged with my team members to discuss and refine these concepts. We held several brainstorming sessions where I presented my ideas and welcomed feedback and suggestions. This collaborative environment allowed us to evaluate the feasibility and potential impact of each proposal critically.

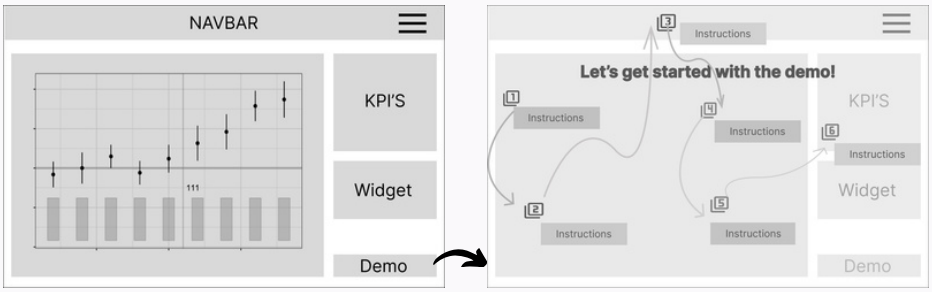
For instance, when discussing the guided walkthrough feature, my teammates suggested enhancing it with multimedia elements such as instructional videos and interactive tutorials. We collectively agreed that incorporating these elements would cater to different learning styles and further improve user engagement. I contributed by researching best practices for instructional design and integrating those insights into our proposal.

New Themes

Similarly, while refining the visual analytics dashboard concept, we deliberated on the most relevant metrics and key performance indicators (KPIs) to include. I proposed focusing on metrics such as machine uptime/downtime, task completion rates, and scheduling adherence, which are crucial for operational efficiency. Collaborating with team members who had expertise in data visualization, we designed mock-ups that effectively conveyed these metrics in a clear and concise manner.

04
CONCEPT
DEVELOPMENT

KISHORE SHAW

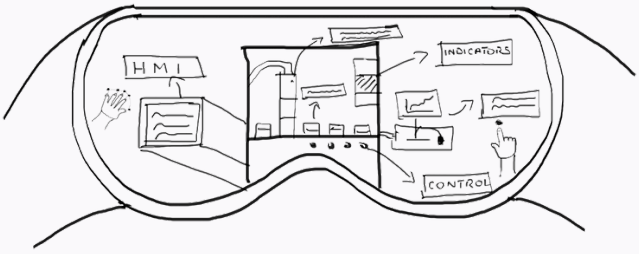


Description

Solution: Comprehensive and interactive onboarding experience along with guided tutorials to help users understand the functionalities of the Mach 4.0 desktop.

Reason

problem: The operation is complex and requires knowledgeable personnel to manage, making it difficult for users to operate independently.
Stakeholders Requirements:
Increase Training: Provide support or training for machine operation. Add a step-by-step user guidance interface to instruct users on how to set up and run demonstrations.

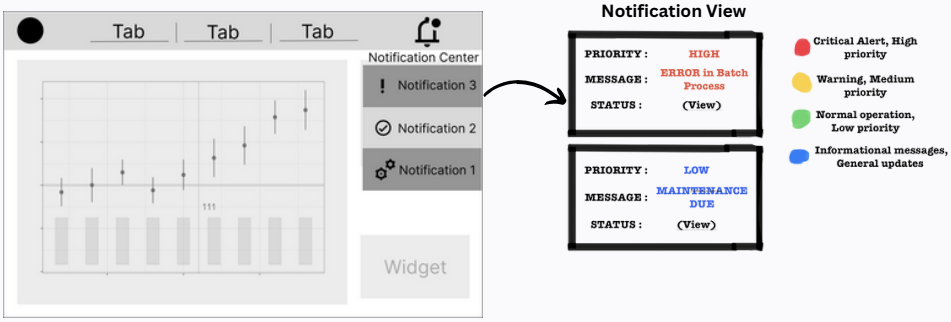


Reason

Stakeholders Requirements:
Enhance Interactivity: Provide interactive content instead of just text descriptions.

Description

Solution: Design Idea of using immersive VR training environment where users can get knowledge of different part functionalities and learn to use the Mach 4.0 platform effectively.



Description

Solution: Designed for user awareness and prompt timely actions through intelligent notifications.

Reason

Stakeholders Requirements:
Add Alert Features:
Implement automated fault detection and handling to ensure the system can self-repair or notify users when issues arise.

REFLECTION

The ideas and solutions developed during the ideation phase laid a strong foundation for the subsequent stages of our project. The proposed interactive user interface and visual analytics dashboard became central components of our design strategy, guiding our development efforts towards creating a more user-friendly and efficient Mac 4.0 platform.

Keywords and Coding

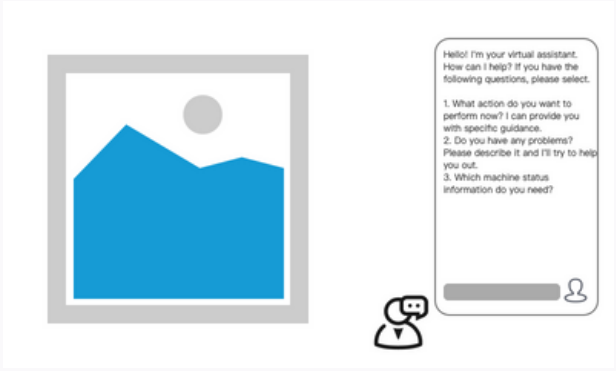
Participating in the ideation process was an enriching experience that enhanced my skills in creative thinking, collaboration, and user-centered design. I learned the importance of grounding innovative ideas in actual user needs and feedback, ensuring that our solutions address real-world challenges effectively.

I also recognized the value of diverse perspectives in strengthening and refining ideas. Engaging with my teammates allowed me to see different angles and consider aspects I might have overlooked initially. This collaborative synergy was instrumental in developing well-rounded and practical solutions for the project.

Furthermore, navigating through constructive criticism and iterative refinement taught me to be adaptable and open-minded. I understood that initial ideas often serve as starting points that evolve through discussion and feedback. Embracing this process led to more robust and effective outcomes.

04
CONCEPT
DEVELOPMENT

CHENYING TIAN



Description

Virtual assistants can significantly improve user experience and operational efficiency by answering questions, providing suggestions, and offering real-time guidance. They help troubleshoot, answer common queries, and provide operational steps and optimization suggestions.

Reason

Problem: The operation is complex and requires knowledgeable personnel to manage, making it difficult for users to operate independently.
Stakeholders Requirements:

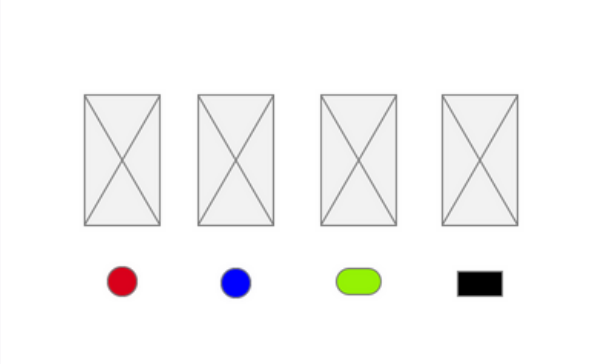
- Increase Training: Provide support or training for machine operation. Add a step-by-step user guidance interface to instruct users on how to set up and run demonstrations.
- Enhance Interactivity: Utilize chatbots to enhance user interaction with the platform.

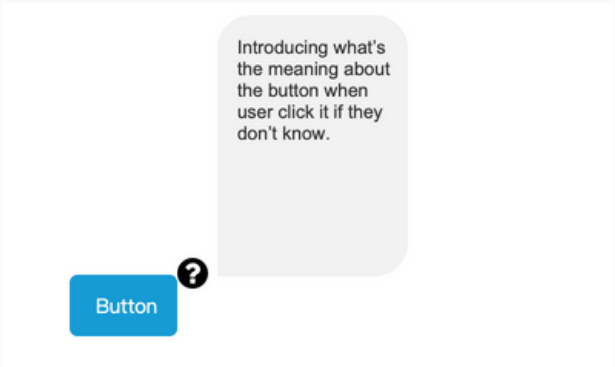
Description

Ensure control buttons for each machine are clearly visible and easy to operate. To avoid accidental activation, provide clear color-change feedback after pressing and design buttons with distinct graphics for better visual distinction.

Reason

Problem: While the current user interface has basic functionality, it is not intuitive. Users unfamiliar with the interface find it difficult to quickly understand its features.
Stakeholders Requirement:
Improve User Interface: Provide a more intuitive user interface that allows users to easily understand specific functions.





Description

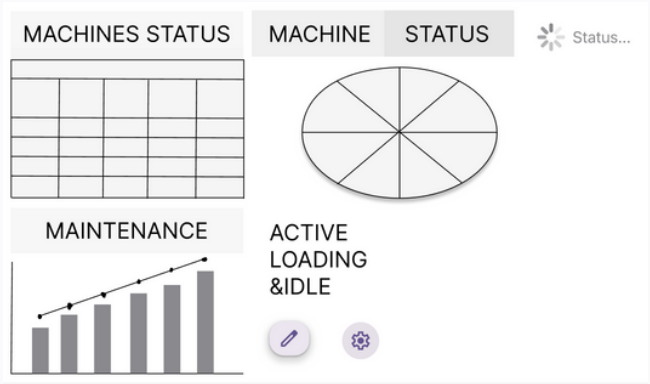
Place a small informational icon next to each interface element that needs to be explained. When the user hovers over the icon, a tooltip is displayed that explains what the element does, reducing the learning curve for new users

Reason

Stakeholders Requirement:
Enhance Interactivity: Provide interactive content instead of just text descriptions.

04
CONCEPT
DEVELOPMENT

Huaibo Zhang



Description

Develop a visual data dashboard that integrates multiple data sources to help management monitor production in real-time.
Features include:

- Integrate factory data: production progress, equipment status, and inventory levels.
- Offer various data visualizations: line charts, bar charts, and pie charts.
- Real-time data updates for accuracy and timeliness.

Reason

Stakeholders Requirement:
Clear Information Display:
When viewing an individual machine, users should see which tasks are scheduled, which workpieces are allocated at specific times, the machine's actual working time, time spent on loading, and time spent in maintenance.

Description

Create a tool to track and display production progress, helping management understand the production status.
Features include:

- Display the current progress of production tasks and estimated completion times.
- Provide detailed information and status for each production stage.
- Allow users to set key production milestones and send notifications when they are reached.

Reason

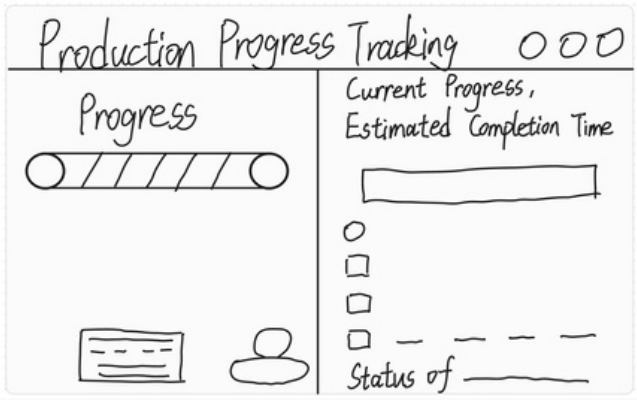
Stakeholders Requirements:

- Clear Information Display:

When viewing an individual machine,Users should see scheduled tasks, allocated workpieces, actual working time, loading time, and maintenance time for each machine.

- Add Alert Features:

Implement automated fault detection and handling to ensure the system can self-repair or notify users when issues arise.



Description

Develop an application that allows users to remotely control simple equipment operations.
Features include:

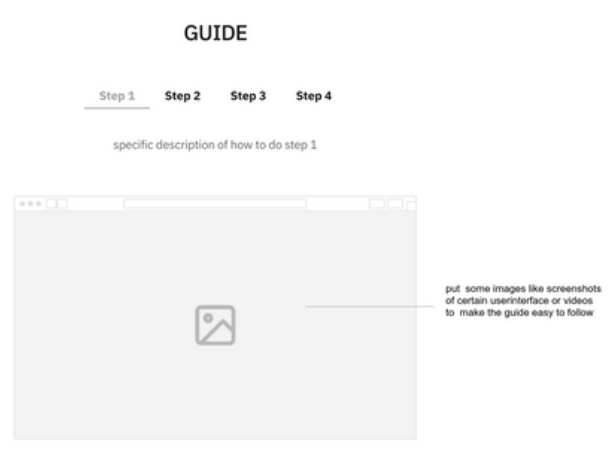
- Remotely start and stop equipment.
- Provide basic operation records and display operation history.
- Support multi-user permission management to ensure operational security.

Reason

problem: The operation is complex and requires knowledgeable personnel to manage, making it difficult for users to operate independently.
Stakeholders Requirement:
Enhance Interactivity: Provide interactive content instead of just text descriptions.

04
CONCEPT
DEVELOPMENT

Huaibo Zhang



Description

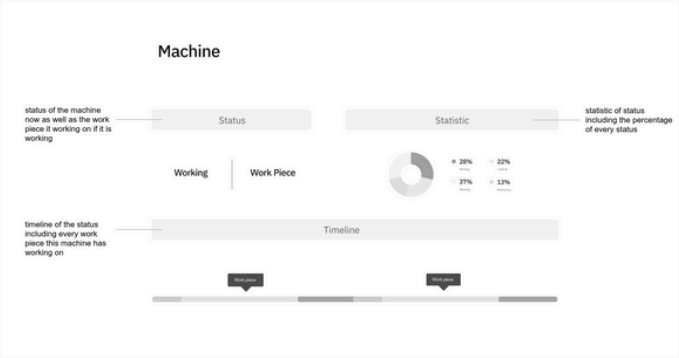
Solution: Provide guides that instruct individuals on how to run the demos, including step-by-step guides and a chatbot.

Reason

problem: The operation is complex and requires knowledgeable personnel to manage, making it difficult for users to operate independently.

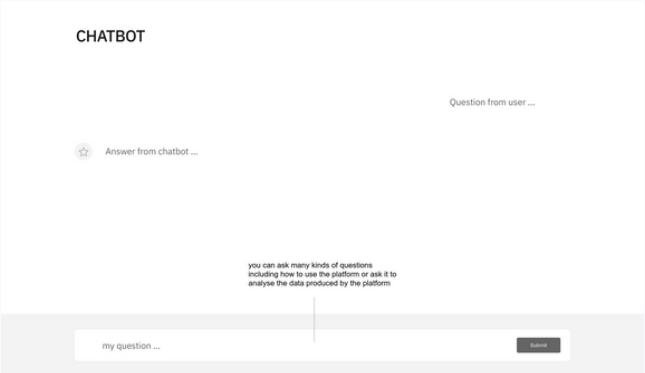
Description

Solution: Redesign the user interface to consolidate important information, including the status of the machine and other relevant details



Reason

Stakeholders Requirement:
Clear Information Display:
When viewing an individual machine, Users should see scheduled tasks, allocated workpieces, actual working time, loading time, and maintenance time for each machine



Description

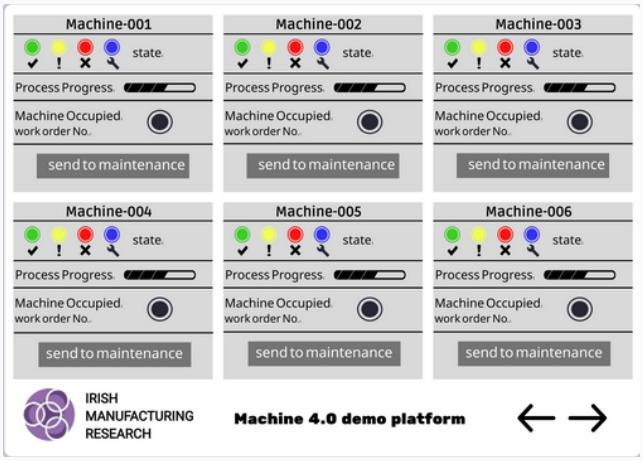
Solution: Deploy AI models to chatbot, making it capable of analyzing the data produced by the platform

Reason

Stakeholders Requirement:
Clear Information Display: Add paralytics features to show the scheduling process

04
CONCEPT
DEVELOPMENT

Huaibo Zhang



Solutions:
Use simple and clear icons to indicate machine status and task progress, and implement colour coding to represent different statuses (e.g., green for normal operation, yellow for warning, red for error, and blue for maintenance).

Reason

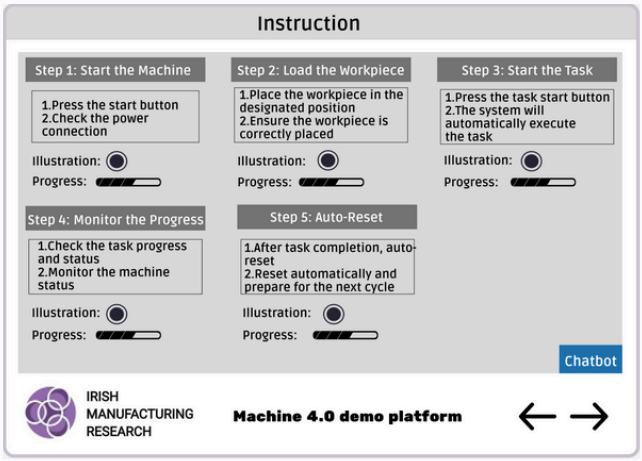
Problem: While the current user interface has basic functionality, it is not intuitive. Users unfamiliar with the interface find it difficult to quickly understand its features.
Stakeholders Requirement:
Improve User Interface: Provide a more intuitive user interface that allows users to easily understand specific functions.

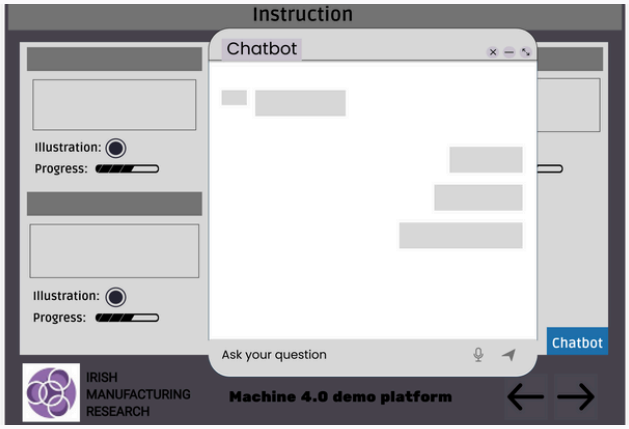
Description

Solution: Add a step-by-step guide to lead users through each operation, with illustrations and progress indicators for each step to simplify machine operations and make it easier for users to operate the machine

Reason

problem: The operation is complex and requires knowledgeable personnel to manage, making it difficult for users to operate independently.
Stakeholders Requirement:
Increase Training: Provide support or training for machine operation. Add a step-by-step user guidance interface to instruct users on how to set up and run demonstrations.





Description

Solution: Provide chatbot support that users can click on a pop-up chat window in the bottom right corner, input questions or voice commands, and interact with a chatbot for help and operational guidance.

Reason

Problem: The user interface is not intuitive and lacks guidance. Labels on the back of the machine show demonstration principles but are rarely read during operation.
Stakeholders Requirement:
Enhance Interactivity: Utilize chatbots to enhance user interaction with the platform.

CO-DESIGN
WORKSHOP

CO-DESIGN **WORKSHOP**

Phase 1

INTRODUCTION

Phase 2

Feasibility Analysis

Phase 3

Selection of the Top 7 Ideas

Phase 4

Scenario Testing

Workshop Goals

The goal of this workshop is to refine these initial solutions proposed last week. This workshop will be conducted within the group, where we will present our own brainstorming ideas to demonstrate potential solutions and inspire further discussion among participants.

Expected Outcomes

Refined solutions

Duration

ACTIVITY	DURATION (Min)
Merging Similar Solutions	10
Feasibility Analysis	10
Selection of the Top 7 Ideas	20
Overall Workshop Duration	50

CO-DESIGN **WORKSHOP**

Phase 1	**Phase 2**	Phase 3	Phase 4
Introduction	**FEASIBILITY ANALYSIS**	Selection of the Top 7 Ideas	Scenario Testing

Activity

We identified similar solutions and merged them to streamline our options. This step helped in reducing redundancy and focusing on unique approaches.

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CO-DESIGN **WORKSHOP**

Phase 1	Phase 2	**Phase 3**	Phase 4
Introduction	Feasibility Analysis	**SELECTION OF THE TOP 7 IDEAS**	Scenario Testing

Activity Understood the needs and challenges associated with the Mach 4.0 platform.

7 IDEAS SELECTED

DEPLOY AI MODELS TO THE CHATBOT

Enhancing the chatbot with AI capabilities to analyze data produced by the platform.

INFORMATIONAL ICONS

Adding small informational icons next to each interface element to provide explanations.

VISUAL DATA DASHBOARD

Creating a dashboard that integrates multiple data sources for real-time monitoring of production.

PRODUCTION TRACKING TOOL

Developing a tool to track and display production progress.

IMPROVED INTERFACE DESIGN

Enhancing the interface with icons and prominent colors to highlight key elements.

DEMO VIRTUAL TOUR

Implementing a virtual tour to guide users through the Mach 4.0 platform.

NOTIFICATION CENTER

Creating a notification center to provide timely alerts and updates to users.

CO-DESIGN **WORKSHOP**

Phase 1 — Introduction

Phase 2 — Feasibility Analysis

Phase 3 — Selection of the Top 7 Ideas

Phase 4 — SCENARIO TESTING

User Persona

Sarah
[Potential Business Client]
Age: 45
Occupation: Operations Executive

Short Description

Sarah has over 20 years of experience in the manufacturing sector. She is responsible for overseeing the production processes and ensuring the efficiency of operations. Her company is looking to invest in new technologies to improve productivity of machine operation, training, understanding the process and reduce downtime.

Goals

- To understand the capabilities of the Mach 4.0 platform.
- To assess how the new machinery can integrate with existing systems.
- To observe the machine's performance matching to their manufacturing unit needs.
- To analyse how the machine operates and what value it brings to their industry.

Challenges

- Ensuring the technology investment is cost-effective.
- Navigating the learning curve associated with new machinery.
- Integrating new systems without disrupting current operations.

CO-DESIGN **WORKSHOP**

Phase 1 — Introduction

Phase 2 — Feasibility Analysis

Phase 3 — Selection of the Top 7 Ideas

Phase 4 — SCENARIO TESTING

User Persona

Short Description

John is a highly skilled engineer with expertise in developing advanced manufacturing technologies. He has been involved in the creation and continuous improvement of the Mach 4.0 platform. John works closely with the research and development team to implement cutting-edge features.

John Doe
[Worked on the development of Mach 4.0]
Age: 38
Occupation: R&D Engineer

Goals

- To ensure the Mach 4.0 platform meets industry standards and user needs.
- To incorporate user feedback into the design and functionality of the platform.
- To transform the machine self-explanatory.
- To innovate and implement new technologies that enhance the platform's capabilities.

Challenges

- Time-consuming demonstration.
- Difficulty of improving the learning curve of the machine.
- Addressing diverse user needs and feedback.
- Keeping up with technological advancements and industry trends

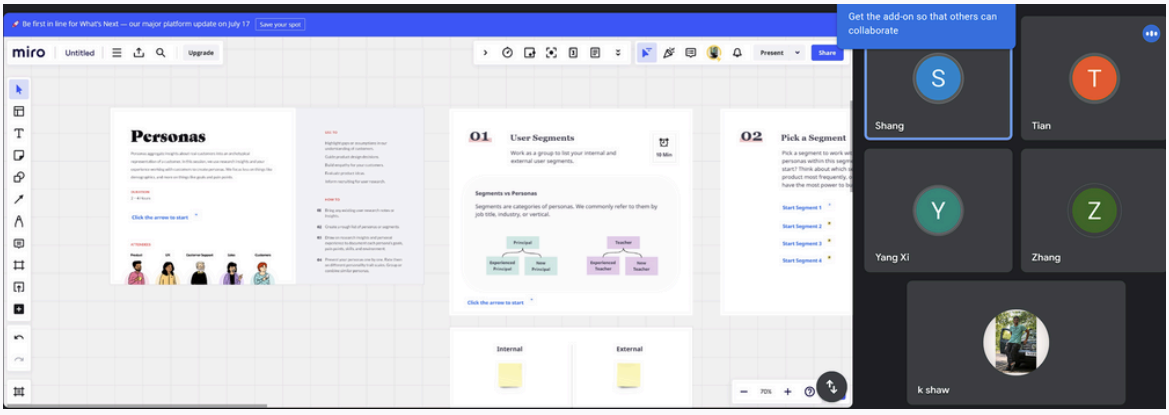

Image depicting our virtual meeting focusing on persona development

CO-DESIGN **WORKSHOP**

Phase 1	Phase 2	Phase 3	**Phase 4**
Introduction	Feasibility Analysis	Selection of the Top 7 Ideas	**SCENARIO TESTING**

Scenario and Feedback

IDEA	SCENARIO	FEEDBACK
DEPLOY AI MODELS TO THE CHATBOT	Sarah intends to operate the machine and wants to understand the different controls to achieve uninterrupted operation.	• The chatbot was able to provide detailed responses to technical questions. • Interaction with the chatbot should be intuitive and user-friendly.
PLACE INFORMATIONAL ICONS	John is new to the company and unfamiliar with the Mach 4.0 platform. He needs to quickly learn how to navigate the interface and understand each element's function to demonstrate it.	• The informational icons provide clear explanations. • Icons should be easily noticeable and could benefit from better placement. • Accurate information or examples could make the icons more helpful.
DEVELOP A VISUAL DASHBOARD	Sarah is also looking for machine with monitoring production metrics and analyze trends to provide reports to interpret their production process for upper management.	• The data dashboard will offer ease to navigate and comprehensive information. • Metrics needed to be precise. • Adding customizable views could improve the dashboard's usability.

CO-DESIGN **WORKSHOP**

Phase 1	Phase 2	Phase 3	**Phase 4**
Introduction	Feasibility Analysis	Selection of the Top 7 Ideas	**SCENARIO TESTING**

Scenario and Feedback

IDEA	SCENARIO	FEEDBACK
TOOL TO TRACK AND DISPLAY PRODUCTION PROGRESS	User of the machine needs to know which process is undergoing and progress updates of production.	• The tool shows to be effective in tracking production stages and identifying delays. • Adding a feature to predict potential delays could enhance the tool's usefulness.
DEMO VIRTUAL TOUR	Sarah is considering purchasing a scheduling machine platform for her company and wants to understand Mach 4.0 interface and capabilities.	• The virtual tour supports engaging and provides comprehensive overview idea. • Adding interactive elements could make the tour more engaging.
NOTIFICATION CENTER	John needs to stay updated on any quality issues or alerts related to production batches while demonstrating to provide a seamless experience.	• The notifications will improve interaction with timely and relevant information. • Including user-customizable notification settings options could enhance the feature.

CO-DESIGN **WORKSHOP REFLECTION**

In our project, I took an active role in the thematic analysis of the interviews conducted with our stakeholders, Fahim and Daug. This process was essential for taking out the rich qualitative data into meaningful themes that would guide our design decisions. My involvement began with a close reading of the interview transcripts which were recorded and shared by stakeholders, where I focused on identifying key phrases and concepts that were repeatedly emphasized by the interviewees.

Keywords and Coding

Overview of the Workshop

The co-design workshop was a pivotal event in our project, bringing together team members, stakeholders, and potential users to collaboratively brainstorm and refine our design concepts for the Mac 4.0 platform. The workshop aimed to bridge the gap between user needs and technical possibilities by directly involving stakeholders in the design process. This participatory approach ensured that our final design was user-centered and aligned with the practical requirements of those who would be interacting with the platform.

My Role and Contributions

As an active participant in the co-design workshop, I, Kishore Shaw, played a significant role in facilitating discussions and synthesizing ideas from the group. My primary contribution was leading the session on user interface (UI) design, where I guided the participants through a series of activities aimed at identifying key usability features and pain points. I utilized my background in AI and UI design to steer the conversation toward integrating smart, intuitive features that would enhance user experience.

During the workshop, I was responsible for documenting the feedback and suggestions provided by stakeholders. This documentation was crucial in ensuring that the insights gathered during the workshop were effectively translated into actionable design elements. I also contributed to the ideation sessions by proposing the use of AI-driven interfaces that could adapt to different user needs, an idea that was well-received and later became a core component of our design strategy.

CO-DESIGN **WORKSHOP** **REFLECTION**

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Keywords and Coding

Key Insights and Themes

One of the key insights I gained from the co-design workshop was the importance of aligning our design with the real-world workflows of our users. The stakeholders emphasized the need for a more intuitive and streamlined interface, particularly in how information is presented and interacted with on the Mac 4.0 platform. This feedback directly influenced the development of simplified UI layouts and the inclusion of customizable features that allow users to tailor the interface to their specific needs.

Another important theme that emerged was the necessity for real-time data visualization, which was highlighted by several participants as a critical feature for enhancing decision-making processes. I advocated for the integration of this feature, ensuring that it was prioritized in our subsequent design iterations. The collaborative nature of the workshop allowed us to quickly test and refine these ideas, leading to a more user-centric final product.

Personal Reflection

The co-design workshop was a valuable learning experience for me, as it reinforced the importance of user involvement in the design process. Engaging directly with stakeholders provided me with a deeper understanding of their needs and challenges, which was instrumental in shaping my contributions to the project. I also learned the value of flexibility in design thinking—being open to feedback and willing to iterate on ideas based on user input.

This experience underscored the importance of collaboration and communication in design. By facilitating and participating in the workshop, I was able to ensure that the final design was not only technically robust but also genuinely user-friendly. The workshop highlighted my ability to lead, listen, and integrate diverse perspectives into a cohesive design strategy.

DECISION MAKING PROCESS

MACH4.0 BACKGROUND

The Mach 4.0 platform simulates a CNC machine shop environment, showcasing interactions between multiple machines, input/output streams, and a logistics system to demonstrate complex scheduling algorithms.

Key Components

Simulated Machines:

- Quantity: 6 machines.
- Function: Each machine performs different machining functions. Workpieces are processed through stages including loading, processing, and unloading.

Input Streams:

- Quantity: 4 input streams.
- Function: Feed workpieces into the system using feeders that can hold up to 11 workpieces each. The feeders push workpieces one by one into the production process.

Output Stream:

- Function: Collects finished workpieces after processing. These parts are then recycled for subsequent demos.

Logistics System:

- Component: A single robot with a pneumatic suction cup gripper.
- Function: Transports workpieces between input streams, machines, and the output stream.

Buffer Area:

- Slots: 6 temporary storage slots.
- Function: Used for buffering parts between processes.

MACH4.0 BACKGROUND

User Interaction

1、Platform Controls: Buttons: Includes start, reset, soft stop, and emergency stop (E-stop) buttons. Indicators: A light tower with red, amber, green, and blue LEDs indicating the platform's status (e.g., error, running, stopped).

2、User Interface: Human-Machine Interface (HMI): Touch screen for real-time interaction and a computer for development and demonstration purposes.

Human-Machine Interface (HMI):

- Main Page: Displays information about the process machines and allows users to manage machine status (e.g., maintenance mode).
- Secondary Page: Displays information about the buffer, logistics, and feeder machines, primarily for debugging.

Development/Demo Computer: Equipment:

- Standard computer monitor, keyboard, and mouse.
- Use: Connected to the platform network for development purposes, demonstrations, and running scheduling tools.

STEPS TO DECISION MAKING PROCESS

01. IDEAS LAST WEEK

start with the ideas from the workshop last week

02. INTERVIEW REVIEW

review the script of the interview with our partner as well as the results of thematic analysis

03. INGROUP DISCUSSION

After internal discussions, we finalized the design for optimizing the HMI and PC user interfaces, and proposed initial solutions

04. BETWEEN GROUPS

talk with people from other groups and ask their opinion on our designs

05. PARTNER REVIEW

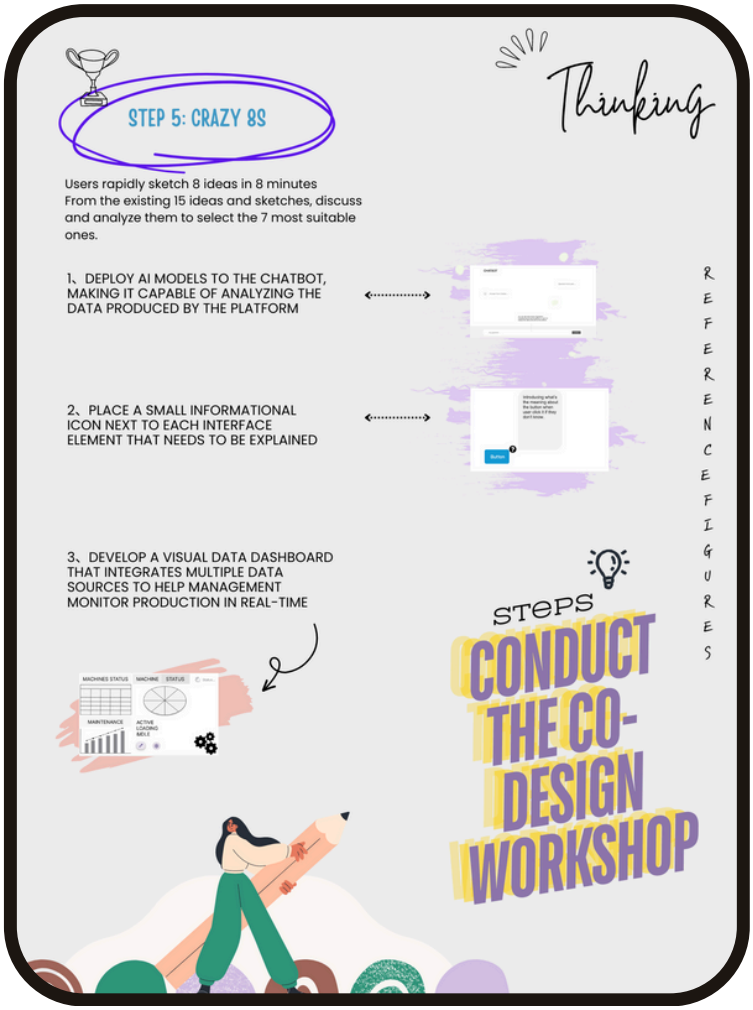
talk with our partner and ask their perspective on our choices

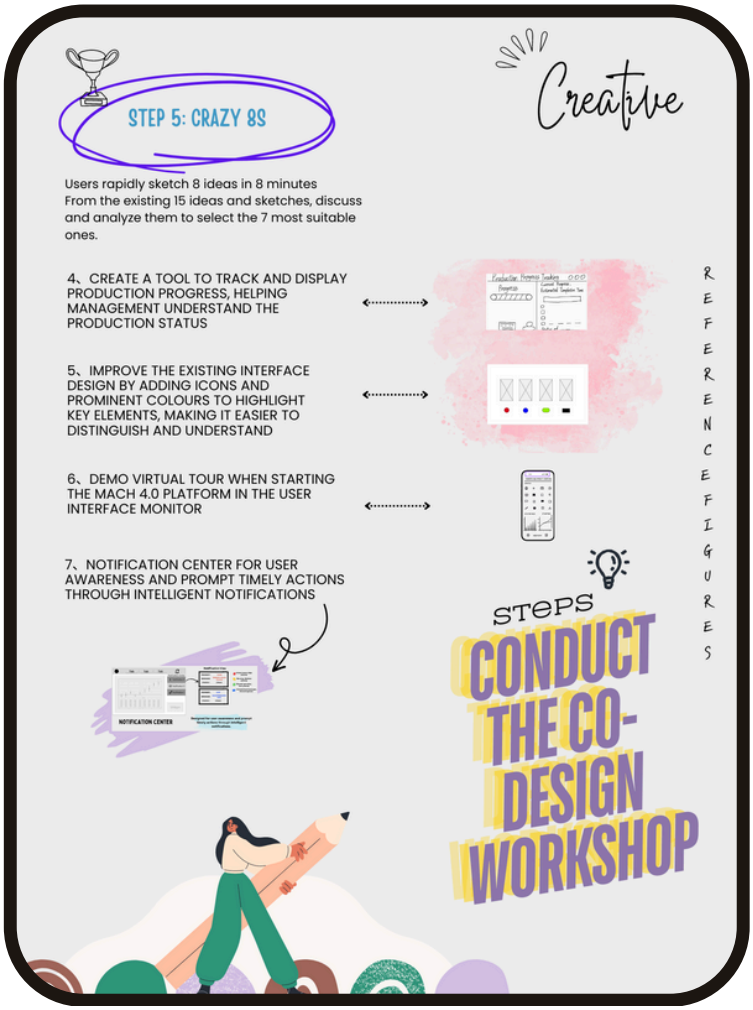
06. FINAL DECISION

make the final decison on the designs

1

STEP 1
IDEAS LAST WEEK





2

STEP 2

INTERVIEW REVIEW

Our interviewee introduced us to the functions of the Mach 4.0 platform, highlighted the challenges it faces, and suggested some improvements. Based on the interview insights and the results of the thematic analysis, we summarised the main issues with the current Mach 4.0 platform:

- Complex operations requiring expertise
- Non-cyclic operation
- Non-intuitive user interface
- Insufficient training and user guidance
- Lack of automated fault detection and notification
- Lack of clear information display
- Poor interactivity

Thematic analysis

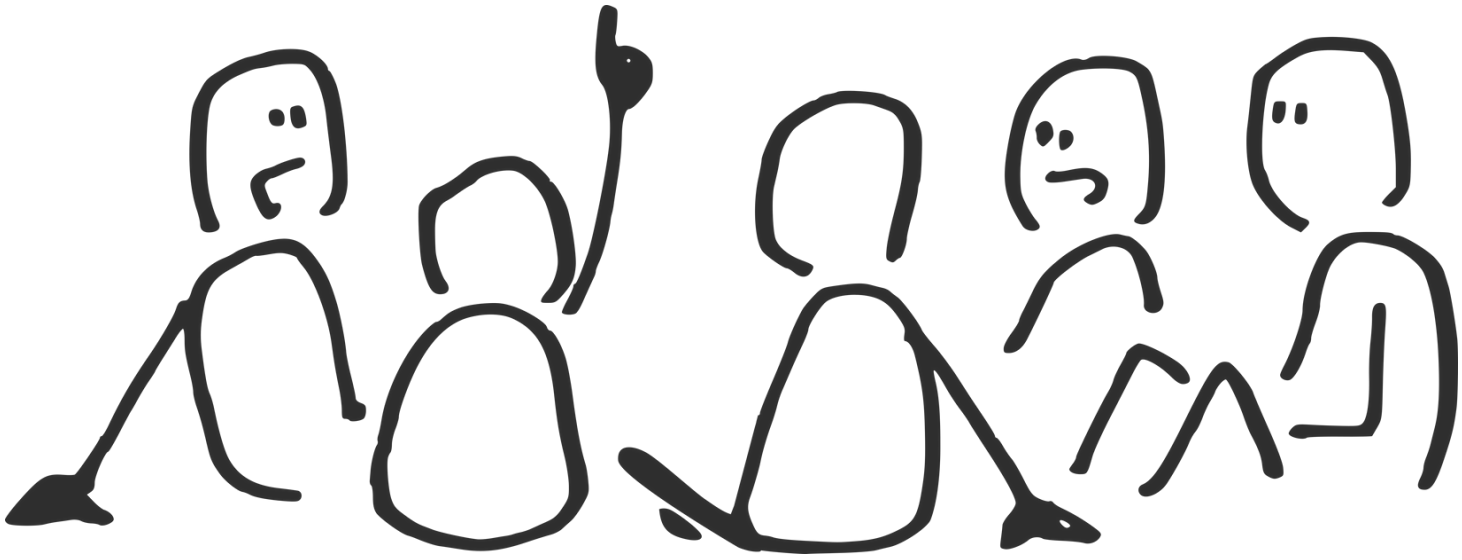
1. Roles and Responsibilities
2. Application of the Mach 4.0 Platform in Manufacturing
3. User Interaction and Task Execution on Mach 4.0 Demo Platform
4. User Interaction and Task Execution on Mach 4.0 Demo Platform
5. User Interaction and Training for Effective Use of the Mach 4.0 Platform

3

STEP 3
INGROUP DISCUSSION

After internal discussions, we finalized the design for optimizing the HMI and computer user interfaces, and proposed initial solutions:

- Improved User Interface: Enhance the intuitiveness and ease of use of the interface.
- Enhanced Interactivity: Integrate technologies like chatbots for better user interaction, enabling intelligent data analysis, personalized user experiences, and automated operations.
- Automatic Cyclic Operation: Enable the system to automatically reset and prepare after each cycle.
- Increased Training: Provide step-by-step user guidance and support.
- Clear Information Display: Develop a visual data dashboard, create tools to track and display production progress, and add analysis capabilities.



Collaborative Decision-Making and Team Dynamics

As we transitioned from ideation to implementation, the team faced several decisions regarding the technical aspects of the project. My background in AI and software development enabled me to assess the feasibility of various proposed features, such as the integration of AI-driven scheduling and predictive analytics. I played a crucial role in evaluating these options, conducting preliminary research to understand the limitations and possibilities of our chosen technologies.

In particular, I led the discussion on whether to implement a fully automated scheduling system or to include manual override options for users. I advocated for a hybrid approach that would offer the benefits of AI-driven automation while still allowing users to intervene when necessary. This decision was made after careful consideration of the feedback from stakeholders who expressed a desire for control over the scheduling process.

Identifying Core User Needs

One of the first major decisions involved identifying the core user needs that would guide our design process. Drawing on the insights gathered from stakeholder interviews and the co-design workshop, I advocated for prioritizing ease of use and real-time interaction as central features of the platform. This decision was crucial in setting the tone for our design strategy, ensuring that our work remained aligned with the practical requirements of end-users.

In our discussions, I contributed by presenting a synthesis of the interview data, emphasizing the recurring themes of "user autonomy" and "intuitive interface design." These themes became foundational in our subsequent decisions, particularly in determining the functionalities to focus on during development.

REFLECTION

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STEP 4

BETWEEN GROUPS DISCUSSION

We obtained feedback and suggestions through workshops and discussions with other teams, which will help us to optimize and refine our design proposal further. Based on this feedback, we made the following improvements:

Distributed Guides and Virtual Tours: To help users operate the demonstration themselves.

Other groups have noted that virtual tour demos can provide users with a more immersive experience and help them better understand the platform's functionality and operational processes.

Visual Data Dashboard and Chatbot Analysis: To clearly show machine status and analyze generated data.

Other groups emphasized the importance of these tools for real-time monitoring and decision-making. By consolidating multiple data sources into a single dashboard, management can better monitor production, respond promptly, and reduce disruptions and losses.

Improved Interface with Information Icons: To make the interface more intuitive.

The other groups thought that this design could significantly improve the intuitiveness and ease of use of the user interface, provide instant help and guidance, and reduce user confusion and errors during operation.

Smart Notification Center: To alert users promptly when a machine malfunctions.

The other groups highlighted the necessity of a smart notification system to ensure timely alerts for machine malfunctions. This feature can help in minimizing downtime and maintaining smooth operations by categorizing notifications based on priority and status.

AI-Driven Training and Assistance: To provide effective training for users.

Other groups believed that incorporating AI-driven training tools would significantly enhance user learning and support. These tools can offer real-time assistance, step-by-step guidance, and personalized support to help users efficiently operate the Mach 4.0 platform.

5

STEP 5

PARTNER REVIEW

We couldn't hold a formal feedback session with our partners this week due to scheduling conflicts. However, previous discussions confirm their strong support for integrating AI models into chatbots. This AI integration is expected to enhance data analysis and user interaction by enabling personalized suggestions and more automated processes. Although formal feedback was missed this week, prior positive responses give us confidence to proceed with this design. We plan to reschedule the feedback session soon to gather more insights.

6

STEP 6
FINAL DECISION

After incorporating the feedback, we finalized the solutions and detailed their implementation. The final solutions include

Improved UI Design: Redesigned with intuitive elements and prominent machine status displays.

Enhanced Interactivity with Chatbots: Integrated AI chatbots for real-time assistance and data analysis.

Automatic Cyclic Operation: Enabled for continuous operation with automated fault detection.

Comprehensive Training Guides: Developed detailed user guides and virtual tours.

Visual Data Dashboard: Implemented for real-time monitoring and decision support.

Smart Notification Center: Sends timely notifications and alerts to users based on event priority.

We have planned to create Hi-Fi prototypes of the selected designs. But, this does not point towards our final design prototype as we will have review sessions and re-iterate the design to meet the needs and challenges it is provisioned to acknowledge Our prototype design have been split between our group to create different design ideas to refine which design can be taken forward to completely work on.

REFLECTION

Reflecting on the decision-making process, I recognize that one of the key strengths of our team was our ability to balance innovation with practicality. My role in this process involved not only bringing forward new ideas but also critically assessing their feasibility and alignment with user needs. This experience has reinforced the importance of an analytical and inclusive approach to decision-making in complex projects. I also learned the value of flexibility—being open to revisiting decisions as new information emerged or as challenges arose during implementation. This adaptability was crucial in ensuring that our final product was both technically sound and user-friendly.

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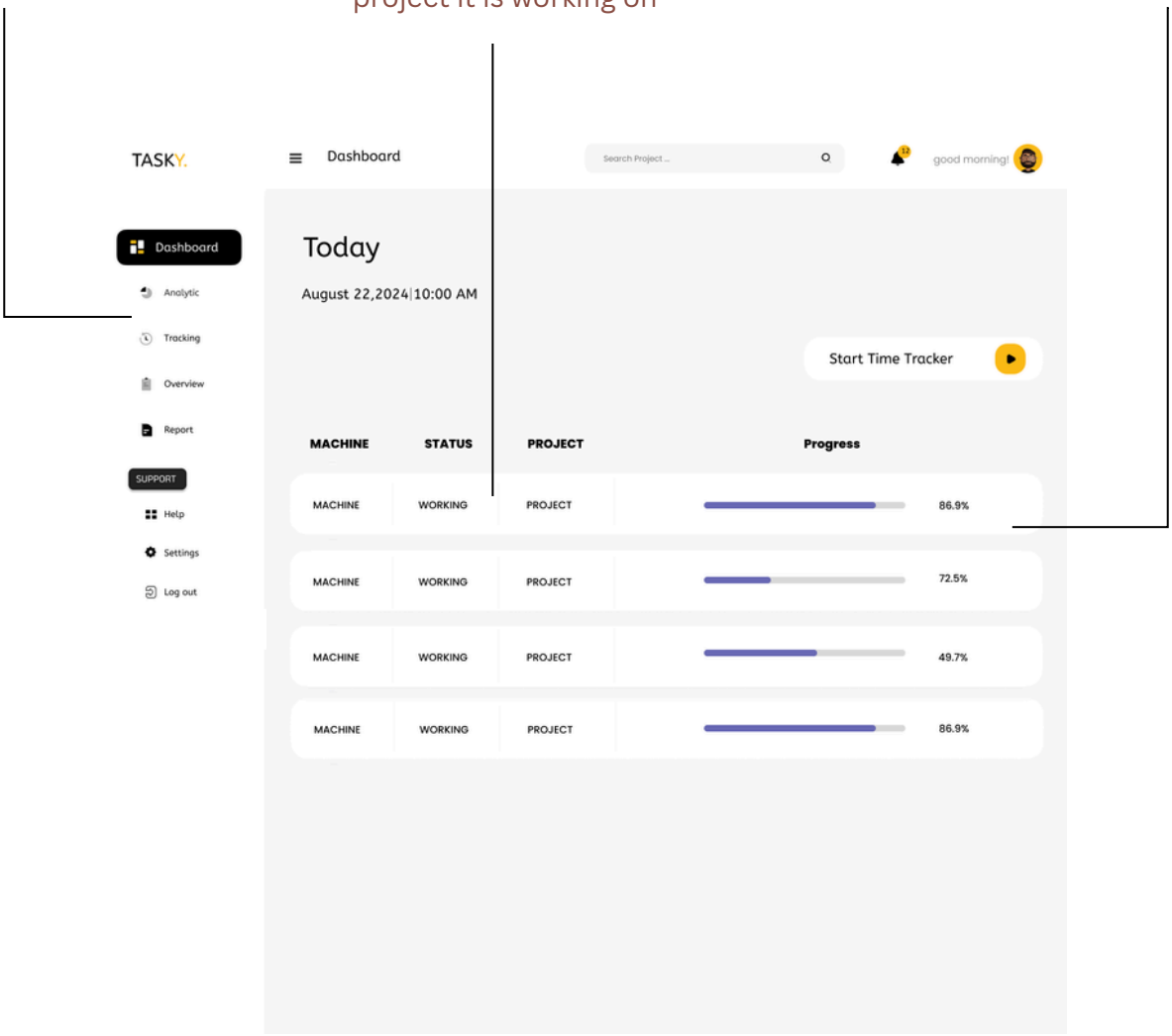
INITIAL DESIGNS

VISUAL DATA DASHBOARD AND PRODUCTION PROGRESS TRACK

navigation

Machine name, status of this machine and the project it is working on

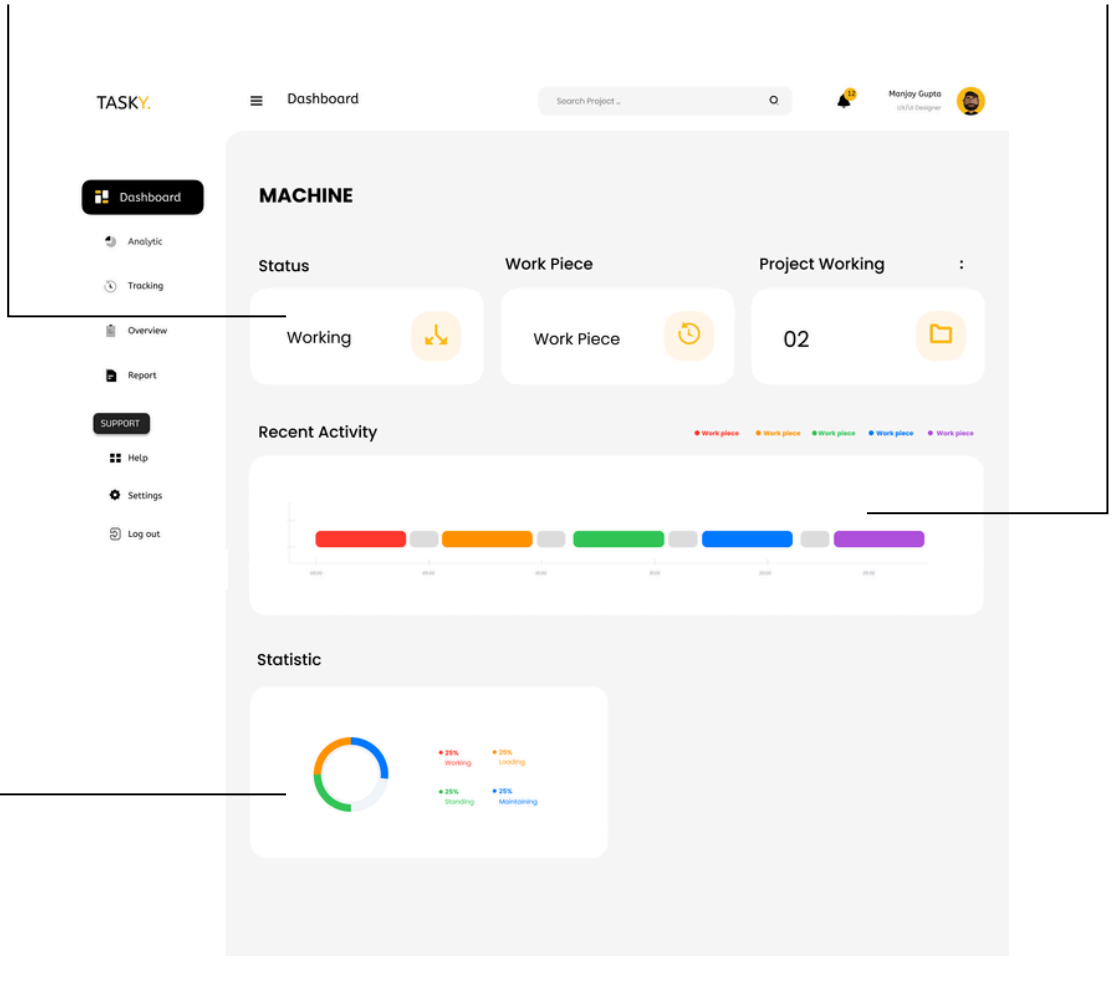
the process of the task this machine working on



VISUAL DATA DASHBOARD AND PRODUCTION PROGRESS TRACK

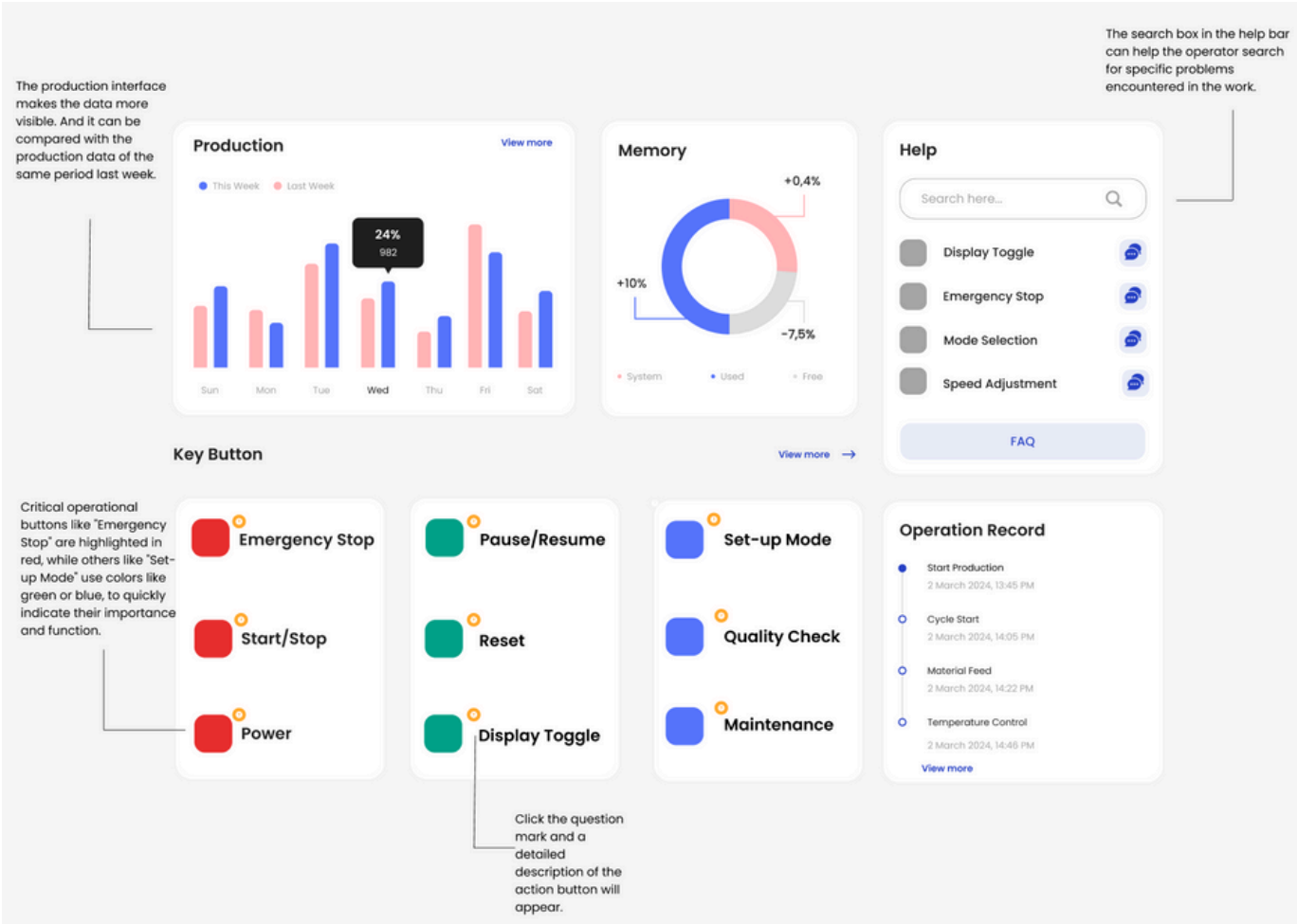
status of the machine, as well as the work piece and the project it is working on

timeline of the status including every work piece this machine has working on

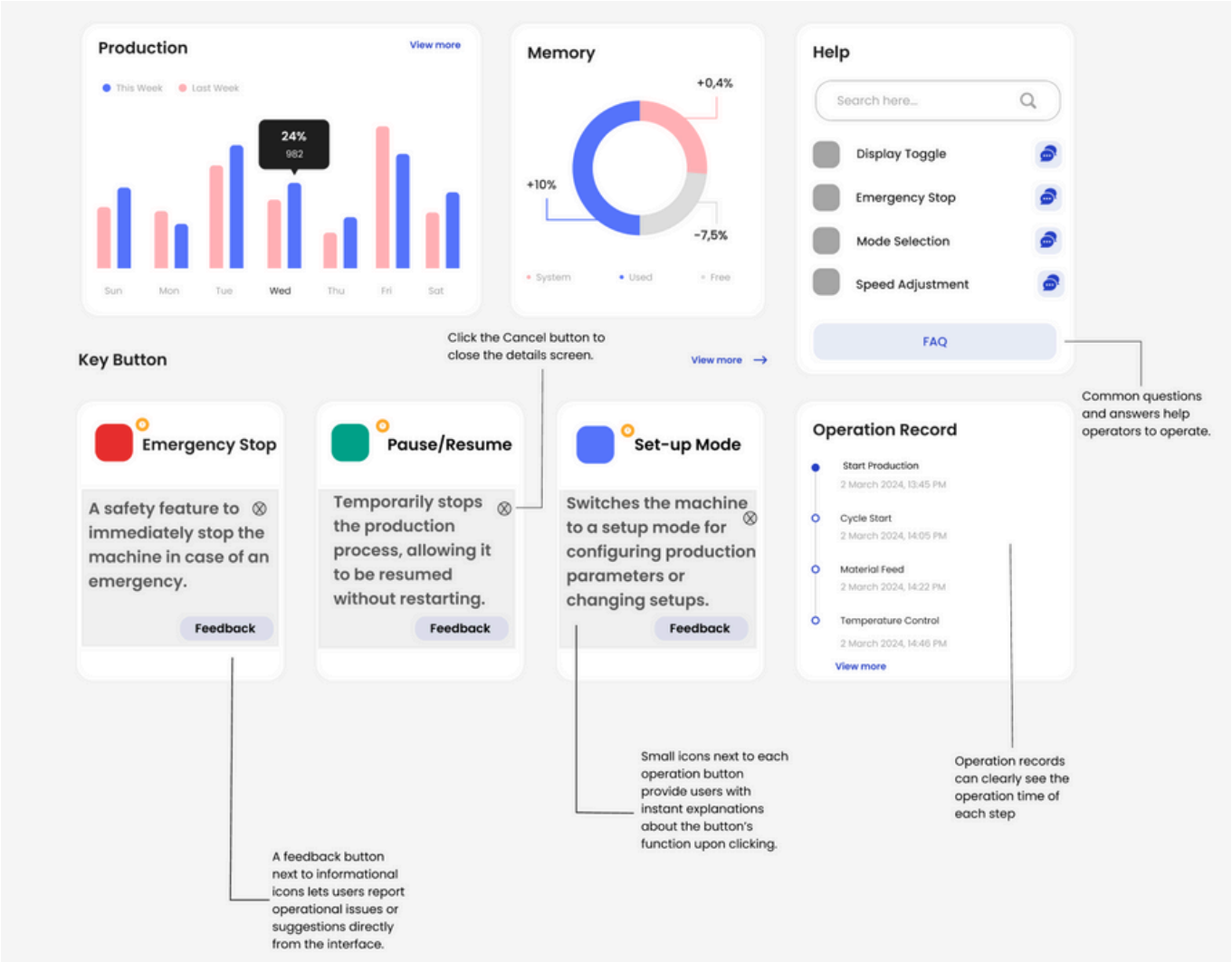


statistic of status including the percentage of every status

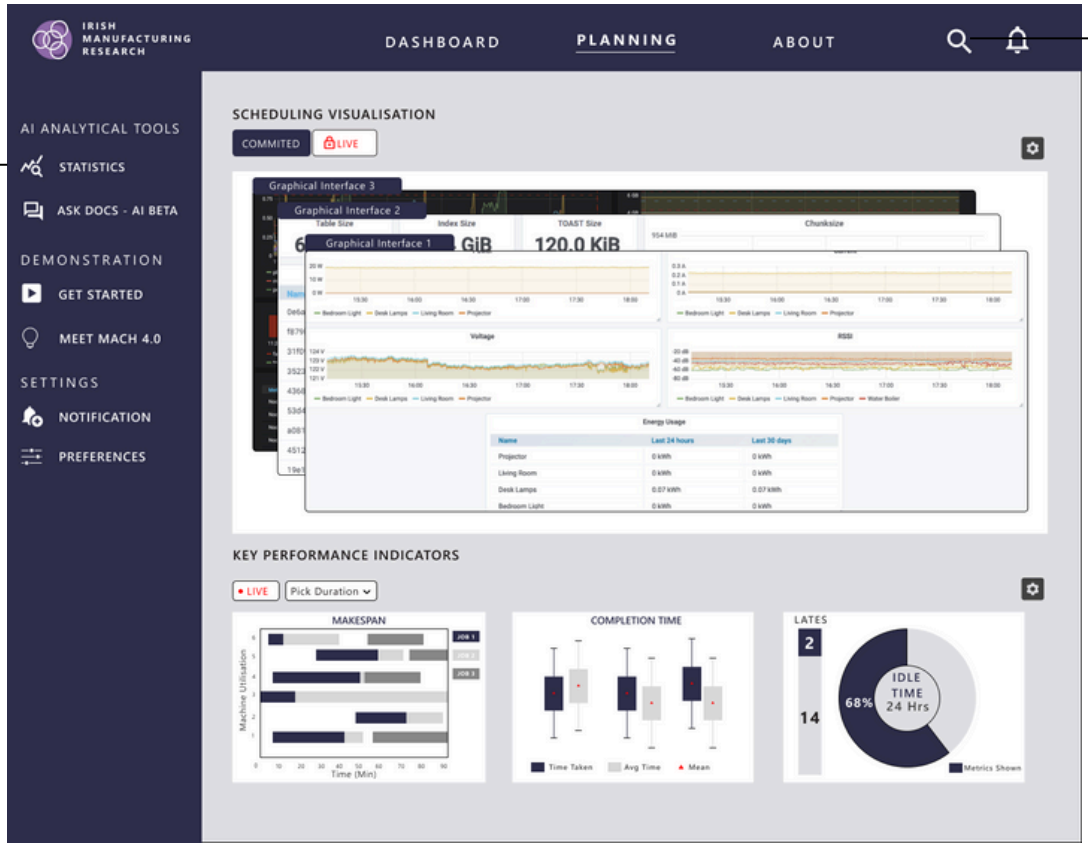
INSTRUCTION AND INFORMATION ICONS



INFORMATION ICONS AND HMI IMPROVEMENT

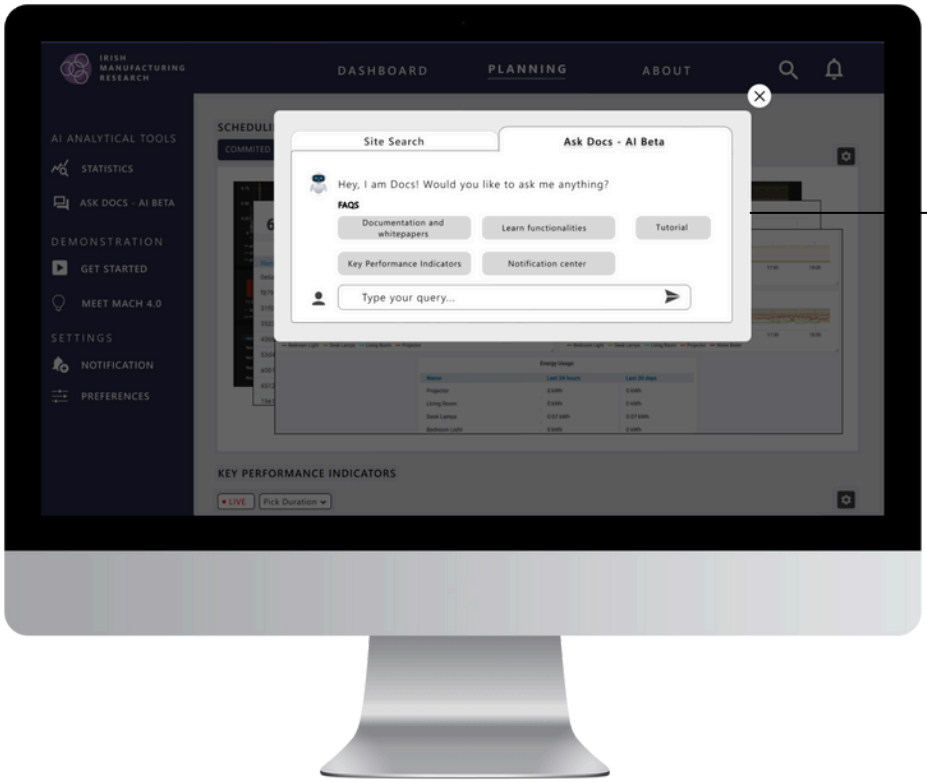


AI MODELS, CHATBOTS, AND NOTIFICATION



The search function provides users two methods of search. It ensures users to quickly find the information they need either by site search to search for a function in the UI or by interacting with LLM based chatbot Docs to search their query. The AI chatbot, named Docs, provides instant support and answers to user queries. This feature enhances user experience by offering real-time assistance and guidance.

The statistics section under AI Analytical Tools provides detailed insights into the performance metrics of the system. Users can analyze data trends, machine utilization, and other key performance indicators, helping in making informed decisions and optimizing operational efficiency.



REFLECTION

As part of the initial design phase for the Mac 4.0 platform, I, Kishore Shaw, focused on developing a user-friendly interface that integrated advanced AI models, chatbots, and a comprehensive notification system. My goal was to create a design that not only met the functional requirements of the platform but also enhanced the overall user experience by leveraging modern AI capabilities.

User Interface (UI) Design

The foundation of my work in the initial design was the user interface. I envisioned a UI that would be intuitive for users while also being powerful enough to handle the complex functionalities of the Mac 4.0 platform. Drawing on the insights gathered from our stakeholder interviews, I prioritized simplicity and accessibility. The UI was designed with a clean, minimalist layout that guided users through their tasks without overwhelming them with unnecessary information.

A key feature of the UI design was the integration of dynamic dashboards. These dashboards provided real-time data visualization, allowing users to monitor the status of the manufacturing processes at a glance. The design also included customizable widgets, enabling users to tailor the interface to their specific needs and preferences, thereby improving efficiency and user satisfaction.

KEY INSIGHTS HELPED IN DESIGN

Integration of AI Models

Recognizing the potential of AI to revolutionize user interaction, I incorporated AI-driven models into the initial design. These models were designed to analyze user behavior and system performance, offering predictive analytics that could inform decision-making processes. For example, the AI models could predict potential system bottlenecks and suggest preemptive actions, thereby reducing downtime and improving operational efficiency.

The AI models were also designed to enhance the personalization of the user experience. By learning from user interactions, the system could offer tailored recommendations and adjust the interface to better suit individual user preferences, making the platform more responsive and user-centric.

Chatbot Implementation

To further streamline user interaction, I introduced a chatbot into the design. This AI-powered assistant was integrated into the UI to provide real-time support and guidance. The chatbot was designed to handle a wide range of queries, from simple navigation assistance to complex troubleshooting, reducing the need for direct human intervention and enabling users to resolve issues quickly.

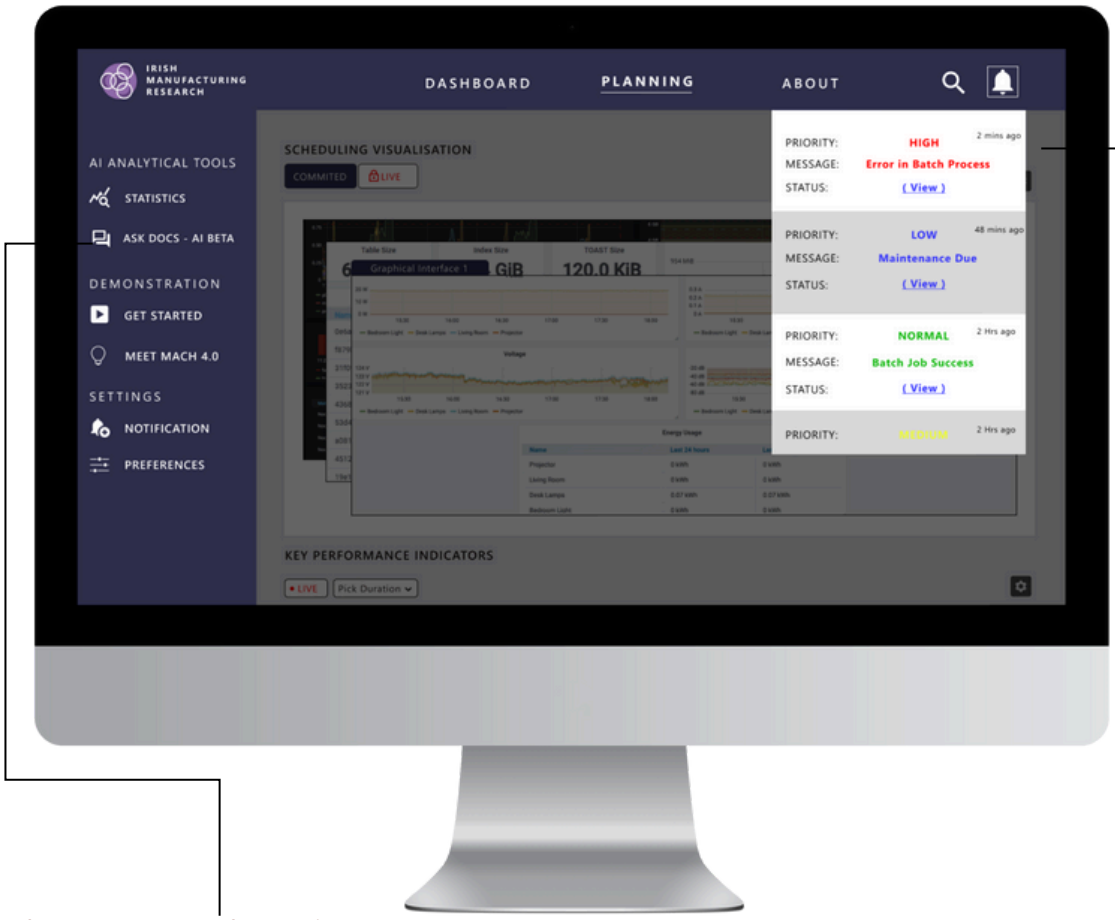
The chatbot was also integrated with the AI models to offer proactive support. For instance, if the system detected an anomaly, the chatbot could automatically notify the user and suggest corrective actions, ensuring that potential issues were addressed before they could escalate.

Notification System

The notification system was another crucial aspect of the initial design. I designed this feature to ensure that users were kept informed of important events and system statuses. The notification system was highly customizable, allowing users to set their preferences for the types of alerts they wished to receive and the channels through which they were delivered (e.g., in-app, email, SMS).

The notifications were also tied into the AI models, enabling the system to deliver intelligent alerts. For example, users could receive notifications not only about current issues but also predictive alerts about potential problems that the AI models identified. This proactive approach was designed to enhance user engagement and keep the platform running smoothly with minimal disruptions.

AI MODELS, CHATBOTS AND NOTIFICATION



The "Get Started" section offers comprehensive demo tutorials to help new users quickly understand and navigate the system. These tutorials provide step-by-step guidance on using various features, making the onboarding process smooth and efficient for new users. (Work in Progress)

The notification center keeps users informed about important events and alerts. Combined with LLMs it can provide important future trends analysis with priority. It categorizes notifications by priority (high, medium, low) and status (error, maintenance, success), ensuring users are aware of critical issues and can take timely actions to resolve them.

FINAL SOLUTIONS

STEPS TO **FINAL SOLUTIONS**

1

Review Decision Making Process

Determine Final Solutions
Obtain feedback and suggestions through workshops, and finalize the solutions

2

Review Previous HiFi Designs

3

System Architecture of Final Solutions

4

Implementation of Final Solutions

- Simulated Machine Floor
- HMI Designs
- Computer UI

01

REVIEW DECISION MAKING PROCESS

Problem Summary and Solutions

Issues with Mach4.0:

- Complex Operation Requiring Expertise:
- Requires knowledgeable personnel to operate; users cannot run the demonstration by themselves.
- Non-Cyclic Operation:
- After the demonstration ends, manual reset and preparation are needed; it cannot run in an automatic loop.
- Non-Intuitive User Interface:
- The current user interface, although functional, is not intuitive. For those unfamiliar with it, understanding and using it is difficult.
- Labels on the back of the machine explain the demonstration's working principles, but these are rarely read when someone is running the demo.

Requirements of stakeholders:

1、Improved User Interface:

- Provide a more intuitive user interface that allows users to easily understand specific functions.

2、Enhanced Interactivity:

- Use technologies like chatbots to enhance user interaction with the platform.
- Provide interactive content rather than just textual explanations.

3、Automatic Cyclic Operation:

- Enable the demonstration to automatically reset and prepare after it ends, supporting continuous operation and reducing manual intervention.
- Add automated fault detection and handling capabilities to ensure the system can self-repair or alert users when issues arise.

4、Increased Training:

- Provide support or training for machine operation, including step-by-step user guidance to instruct users on how to set up and run the demonstration.

5、Clear Information Display:

- When viewing an individual machine, users should be able to see which tasks are scheduled, which workpieces are scheduled at specific times, how long the machine has been working, how long it took to load, and how much time was spent in maintenance.
- Additional feature: Add analysis capabilities to display the scheduling process.

All information comes from our interviewees

01

REVIEW DECISION MAKING PROCESS

DETERMINE FINAL SOLUTIONS

Feedback and Suggestions:

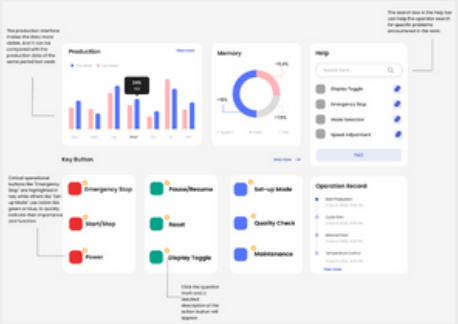
Feedback on the measures was collected through workshops.
Design details were modified during the design process, such as removing the information explanations next to the icons after discussions and instead using more prominent methods to display machine status, changing the existing page layout, etc.

02

REVIEW PREVIOUS **HIFI DESIGN**

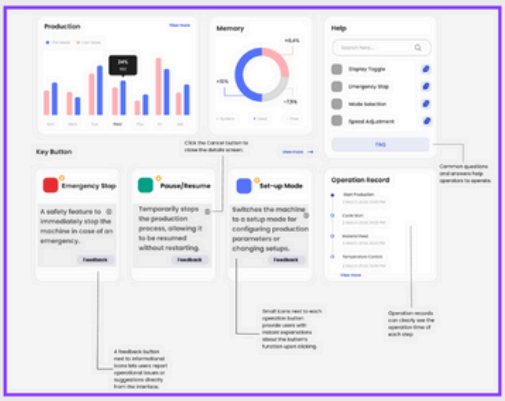
DETERMINE FINAL SOLUTIONS

INSTRUCTION AND INFORMATION ICONS



VISUAL DATA DASHBOARD AND PRODUCTION PROGRESS TRACK

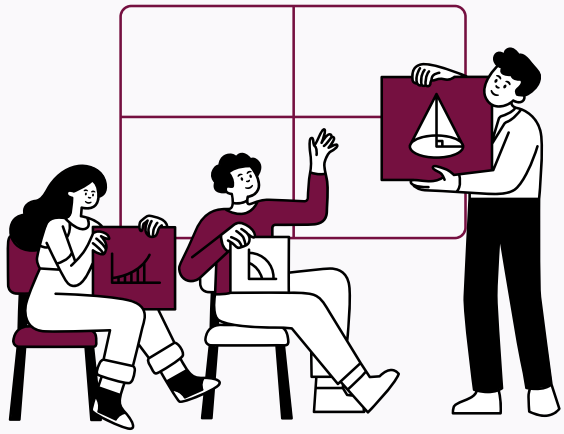
INFORMATION ICONS AND HMI IMPROVEMENT



02

REVIEW PREVIOUS **HIFI DESIGN**

DETERMINE FINAL SOLUTIONS

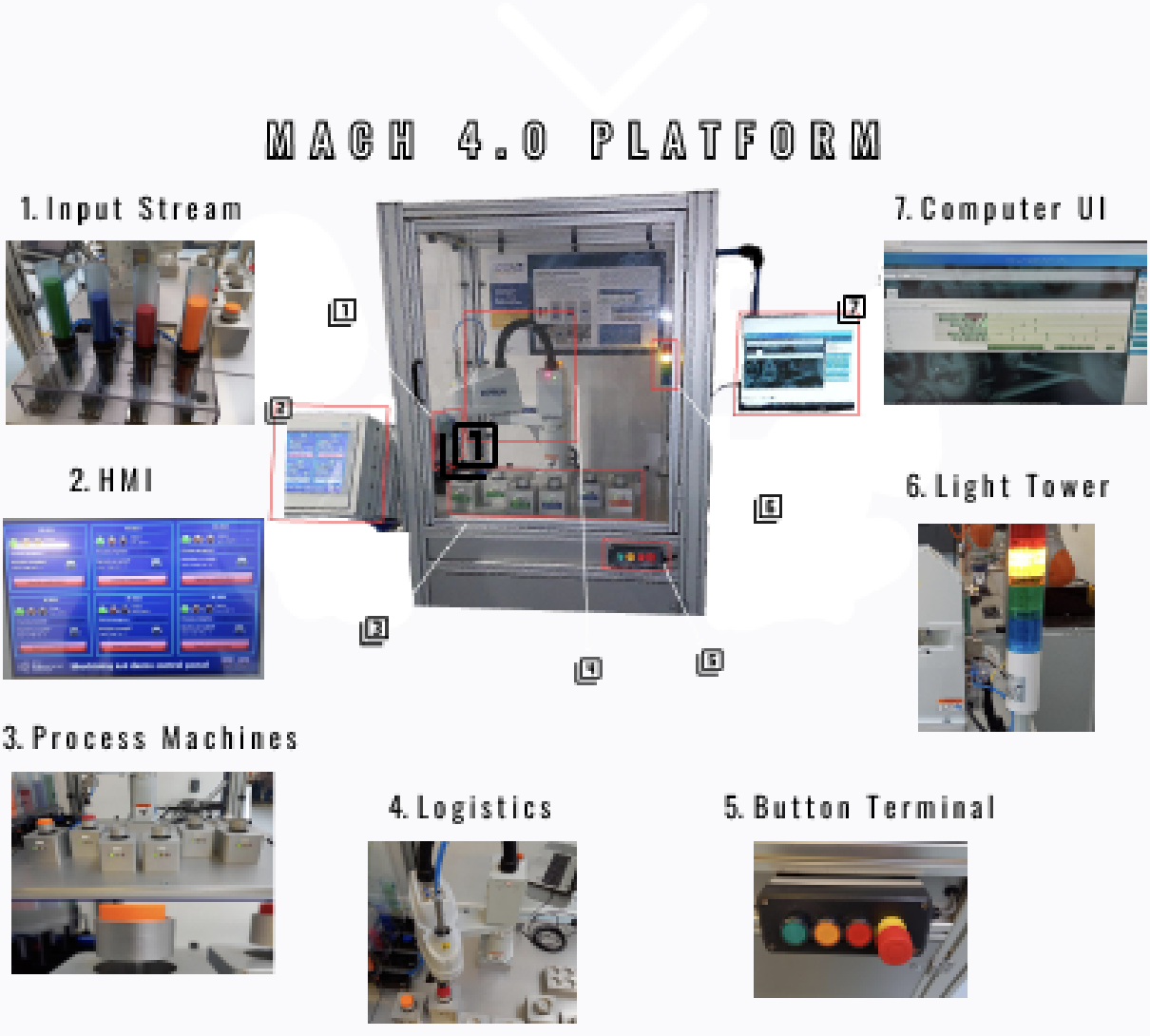


03

SYSTEM ARCHITECTURE OF **FINAL SOLUTIONS**

DETERMINE FINAL SOLUTIONS

IMR designed a self-contained physical platform which can simulate machining floors with multiple machines performing different functions. Main purpose of the platform is to demonstrate work scheduling in a CNC machine shop environment.

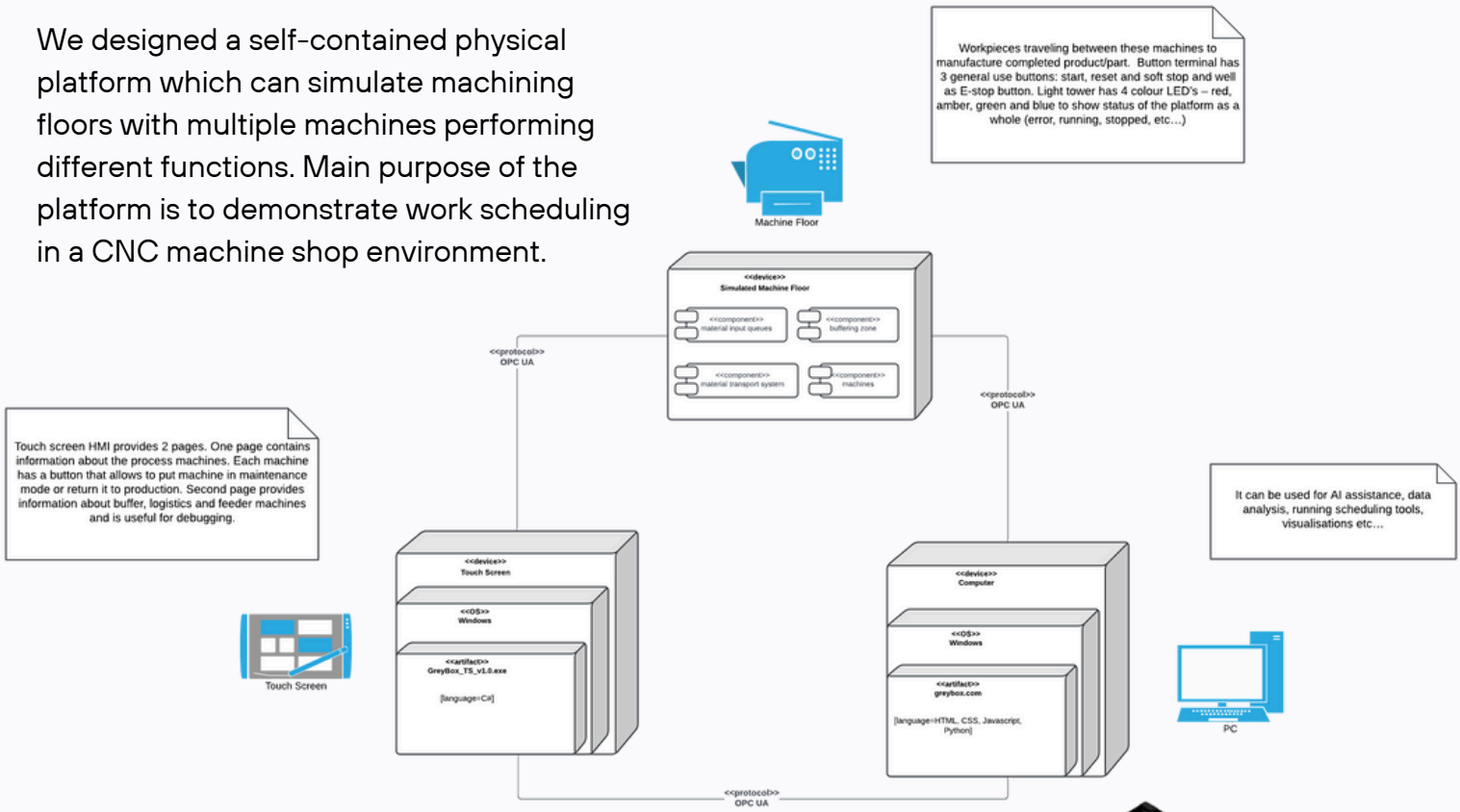


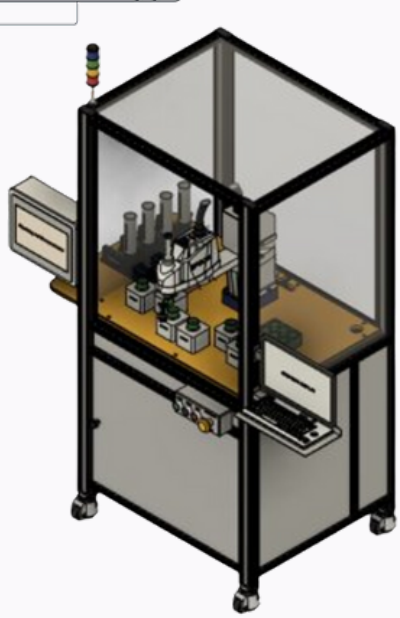
03

SYSTEM ARCHITECTURE OF **FINAL SOLUTIONS**

DETERMINE FINAL SOLUTIONS

We designed a self-contained physical platform which can simulate machining floors with multiple machines performing different functions. Main purpose of the platform is to demonstrate work scheduling in a CNC machine shop environment.

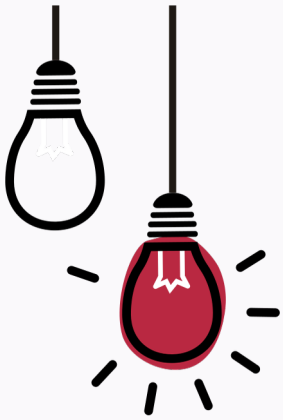




03

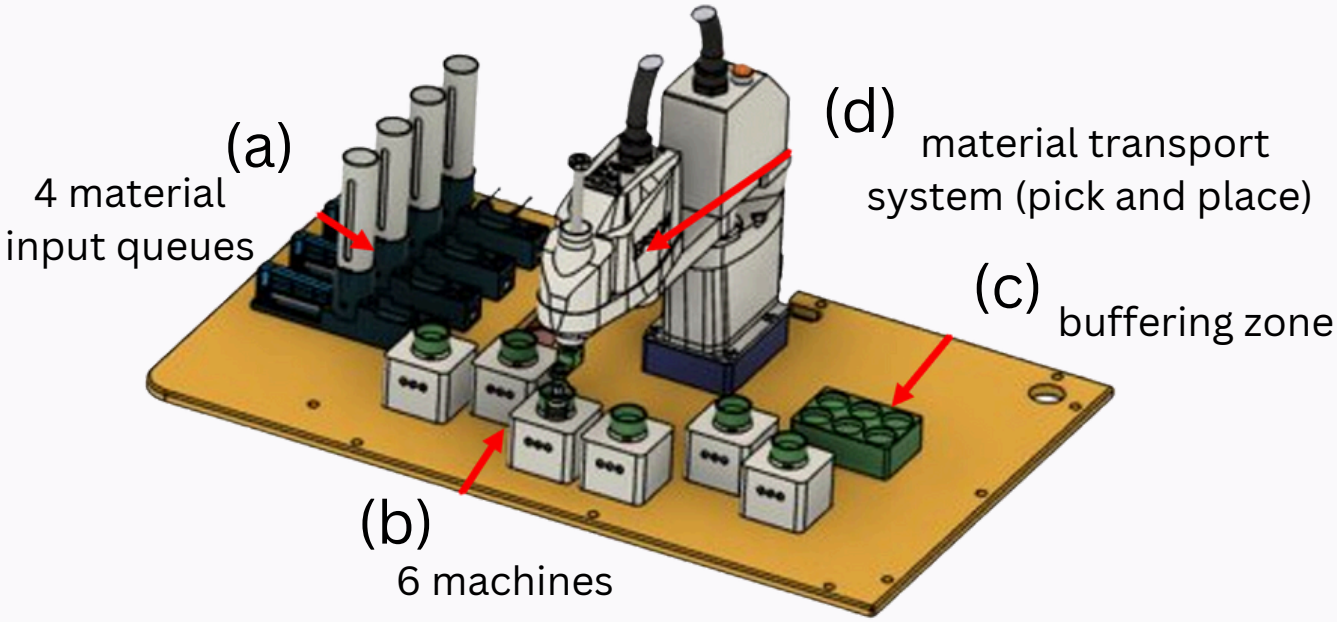
SYSTEM ARCHITECTURE OF **FINAL SOLUTIONS**

DETERMINE FINAL SOLUTIONS



Mach4.0, as an independent physical platform, simulates a CNC machining shop environment, demonstrating the interaction between multiple machines, input/output flows, and logistics systems to illustrate complex scheduling algorithms. This serves as the foundation of our design.

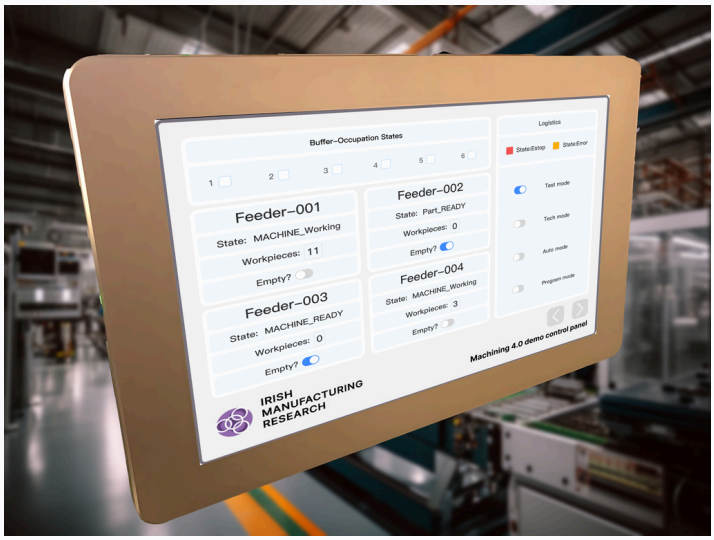
Our task is to optimize the design of the HMI and computer user interfaces to provide a more intuitive user experience, leveraging advanced AI technology to assist in real-time monitoring and management of production progress. This will optimize production processes, enhance operational efficiency, and improve data visualization.

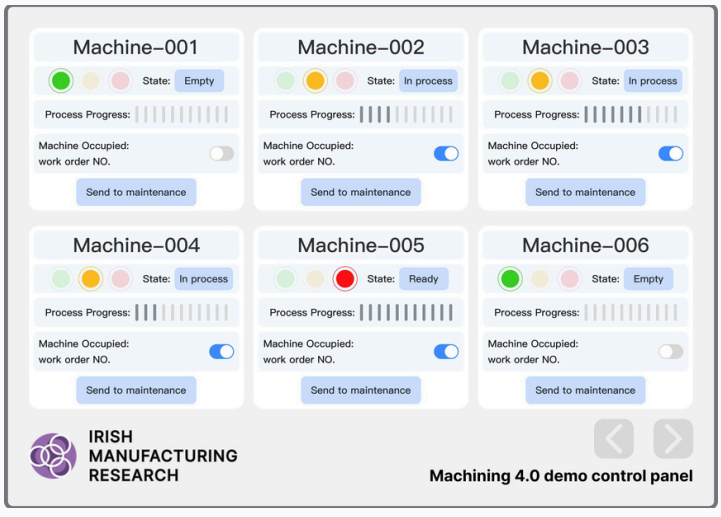


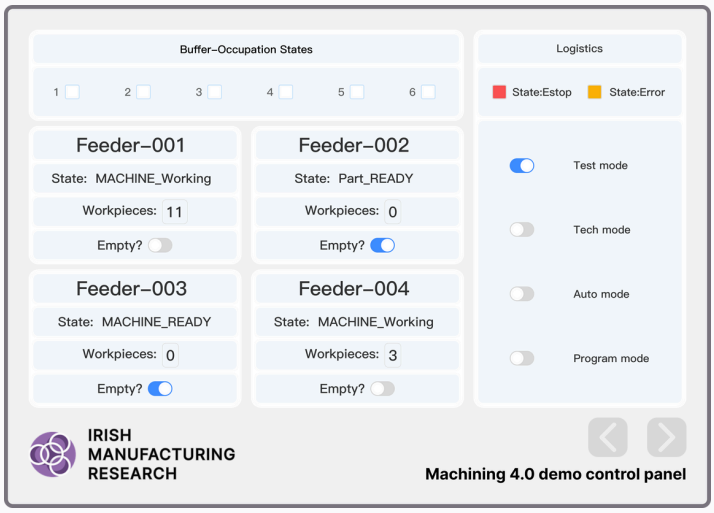
04

IMPLEMENTATION OF **FINAL SOLUTIONS**

HUMAN MACHINE INTERFACE







04

IMPLEMENTATION OF FINAL SOLUTIONS

COMPUTER USER INTERFACE

My approach to implementing the Mach 4.0 platform's user interface focused on three key areas:
User-Centered Design: I prioritized ease of use and accessibility by creating a clean, straightforward layout with a logical flow that allowed effortless navigation. I incorporated dynamic elements such as real-time data displays and customizable dashboards to cater to users' specific roles and preferences.
AI Integration: Leveraging AI models developed earlier, I integrated advanced functionalities like predictive analytics and personalized user experiences. This allowed the UI to dynamically adapt to user behavior, offering tailored recommendations and enhancing overall efficiency.
Responsiveness and Accessibility: I implemented a responsive design to ensure consistent performance across various devices and screen sizes. Additionally, I added accessibility features like keyboard navigation and high-contrast modes to make the platform more inclusive.
HMI Structuring: I contributed significantly to aligning the HMI with the computer interface, ensuring a seamless user experience. By organizing controls and feedback mechanisms to mirror the digital interface, I simplified user interactions, reduced the learning curve, and minimized operational errors.

The Computer User Interface was a critical component of the Mac 4.0 platform, serving as the primary point of interaction between the users and the system. Given the complexity of the platform, it was essential to design an interface that was both intuitive and powerful.
Building on the initial designs, I took the lead in implementing the UI, ensuring that it was fully functional, user-friendly, and aligned with the needs identified during our stakeholder interviews.

04

IMPLEMENTATION OF FINAL SOLUTIONS

COMPUTER USER INTERFACE

Rationale for Final Design Changes
During the development of the Mach 4.0 platform, our team identified the need to refine the initial design to better suit the manufacturing environment. Key changes included adopting Bento grids, enhancing data visualization, and implementing a white color interface, all driven by user feedback and practical considerations.
Bento Grids were introduced to address the need for a more flexible and customizable user interface. This layout allows users to tailor their dashboards according to specific roles and tasks, significantly improving usability and efficiency in a dynamic manufacturing setting.
Enhanced Data Visualization was implemented to support real-time decision-making. Advanced visual tools like interactive charts and real-time graphs were added, enabling users to quickly grasp system performance and identify potential issues, thus facilitating quicker, more informed decisions.
The switch to a White Color Interface was made to improve clarity and reduce visual fatigue. The clean, high-contrast design enhances readability, making critical alerts and notifications stand out, which is essential in a manufacturing environment where operators engage with the system for extended periods.

o better align the Mach 4.0 platform with scheduling needs, I integrated planning tools, AI-driven automation, and a KPI dashboard into the user interface. These additions streamline the scheduling process, making it more intuitive and less confusing for users. The planning tools allow for better organization of tasks, while AI tools automate routine decisions, reducing manual intervention. The KPI dashboard provides real-time insights into performance metrics, helping users quickly assess and adjust schedules, ensuring efficiency and clarity in operations.

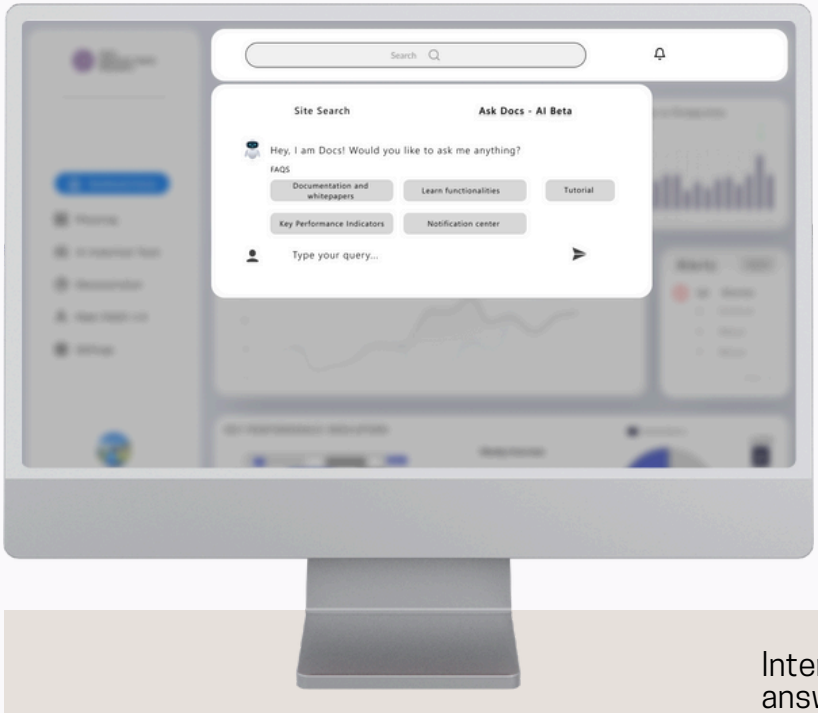
04

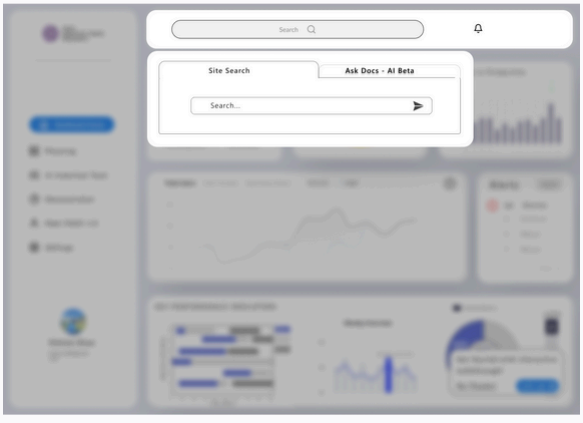
IMPLEMENTATION OF **FINAL SOLUTIONS**

COMPUTER USER INTERFACE

Landin page - Dashboard

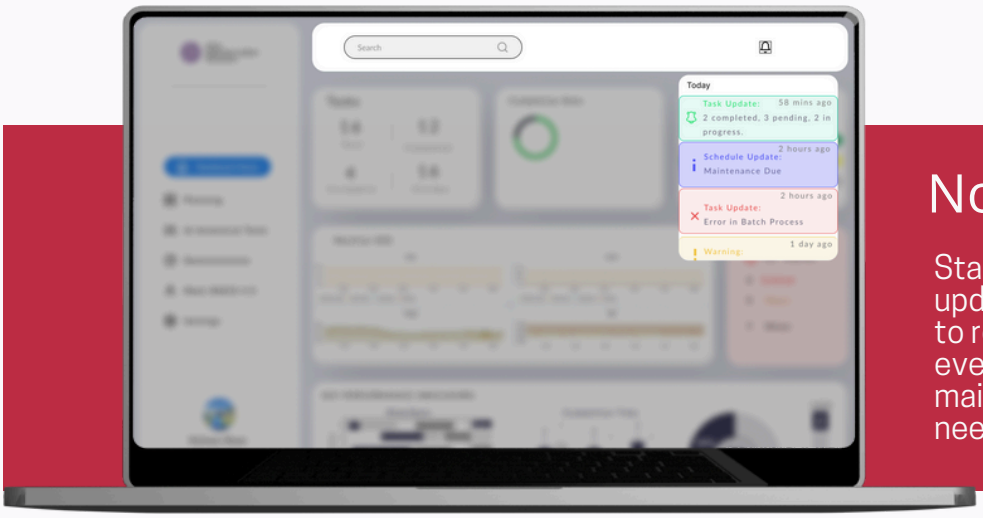
Access key metrics, monitor real-time operations, and get an overview of your system's performance, all from one intuitive and customizable dashboard.





Search functionalities

Interact with AI-powered chatbot for instant answers and support. Whether you need documentation, key metrics, or tutorials, simply ask and get immediate assistance.

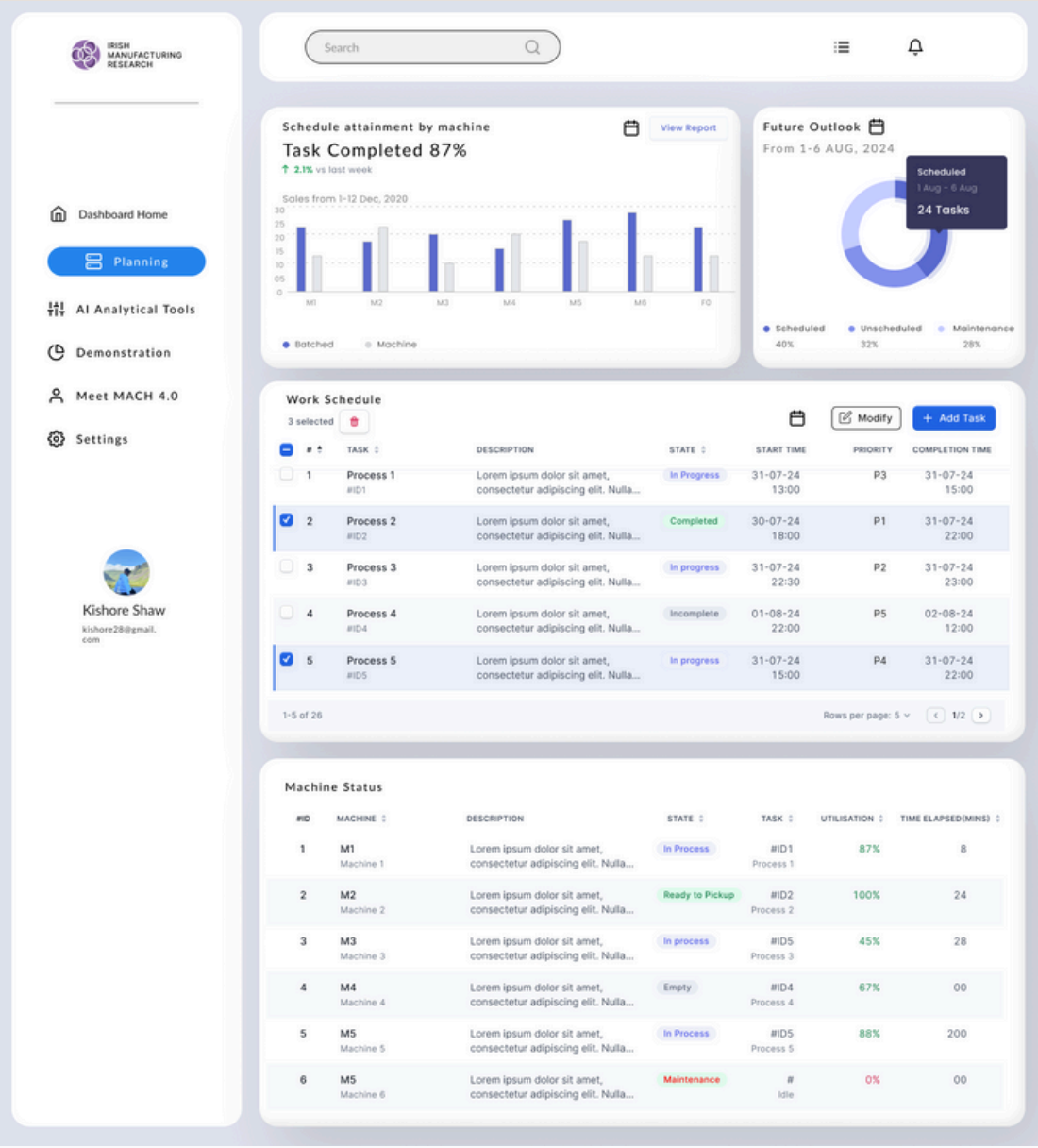


Notification tab

Stay informed with real-time alerts and updates. Customize notification settings to receive important alerts for operational events, system changes, and maintenance updates, tailored to your needs

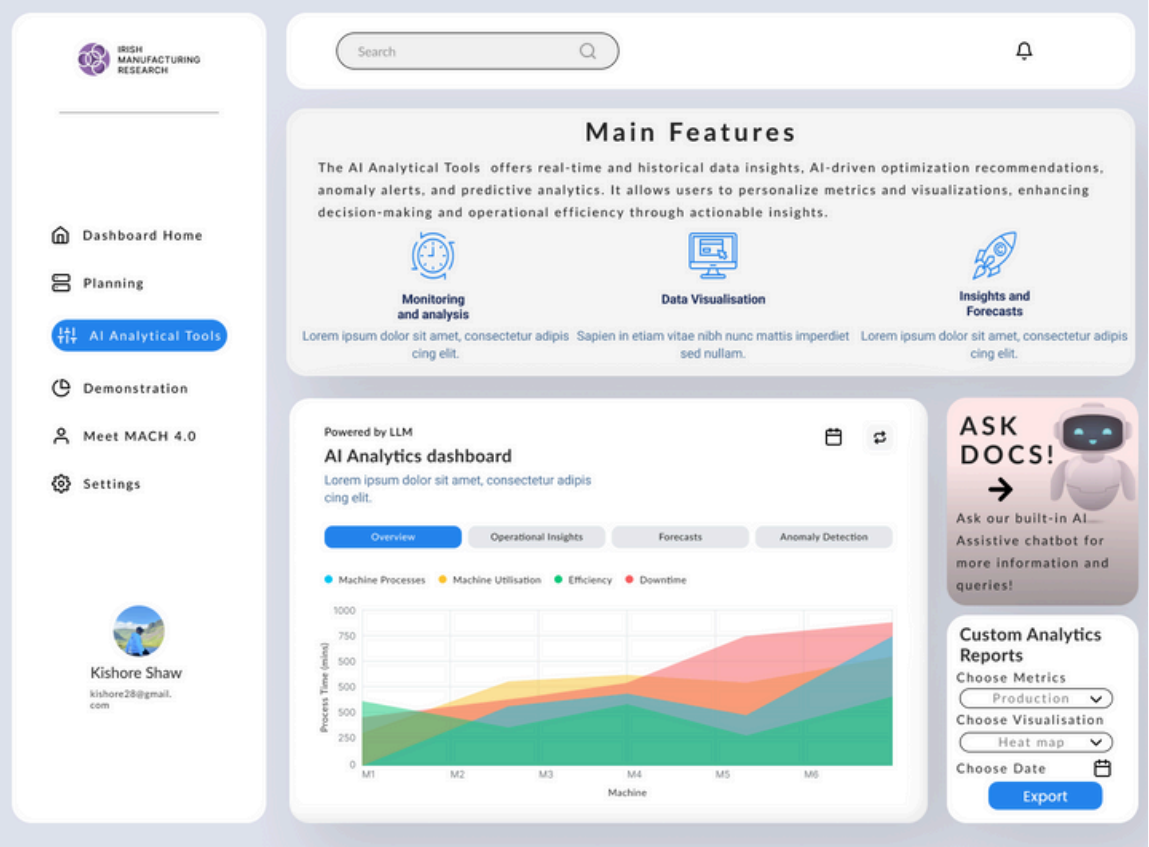
Planning page

Streamline the production with efficient planning tools. Schedule tasks, allocate resources, and monitor timelines to ensure seamless operations and maximize productivity

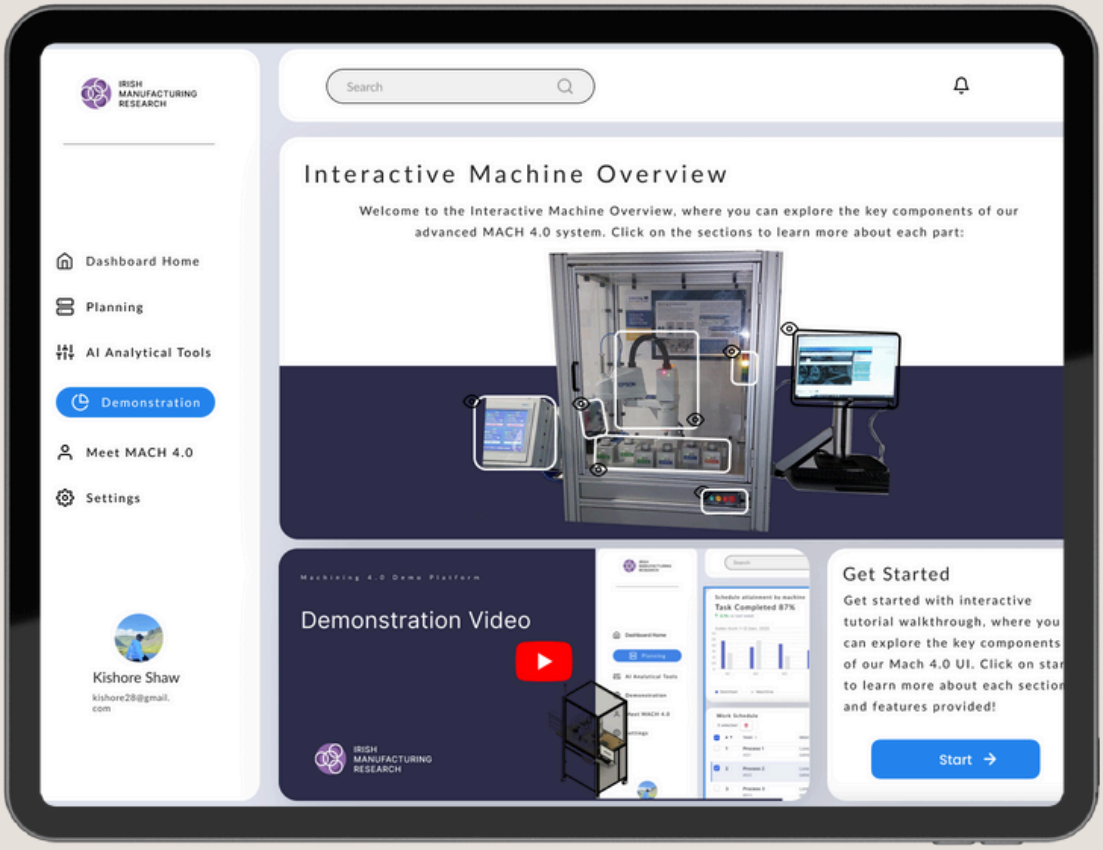


AI analytical tools page

Explore real-time insights, data visualizations, and advanced analytics. Optimize operations with personalized metrics and actionable intelligence, all accessible through a user-friendly dashboard. Access AI Chatbot through the grid and download reports of user preference.



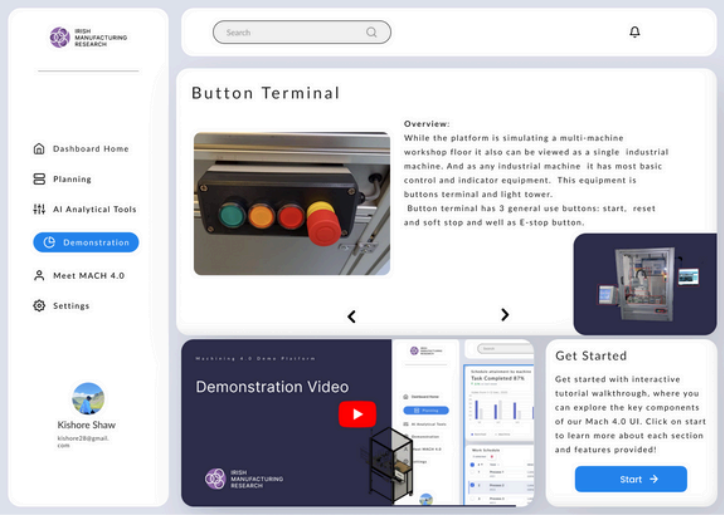
Demonstration page

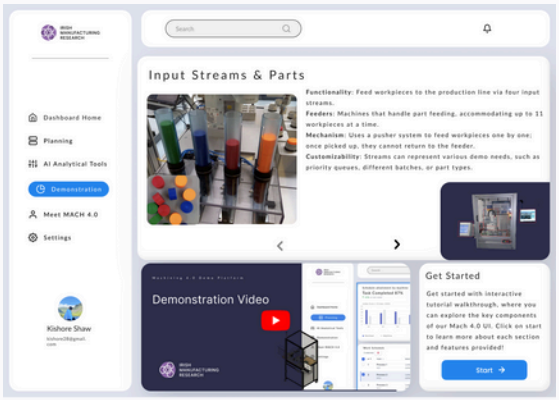


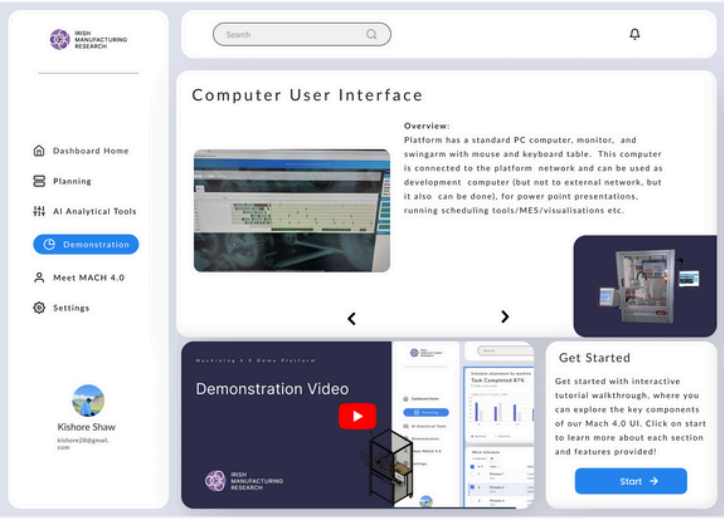
Explore demonstration of MACH 4.0 system with the Interactive Machine Overview, watch a step-by-step Video Tutorial, or Get Started with a guided tutorial for a hands-on experience.

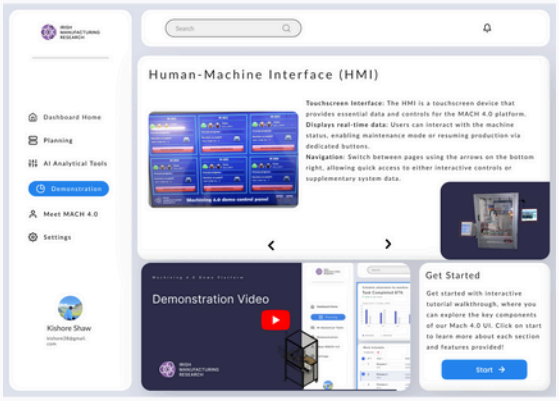
Machine overview pages

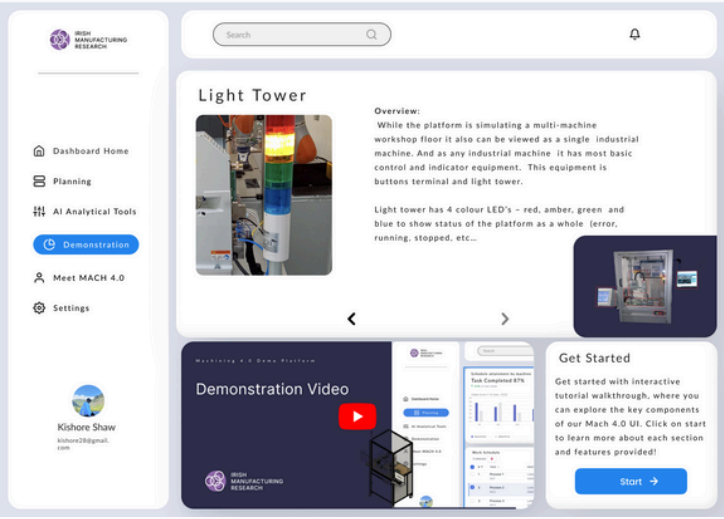
Dive into our interactive demonstration to explore the key components of MACH 4.0. Watch instructional videos, interact with machine components, and start learning interface through guided tutorials.

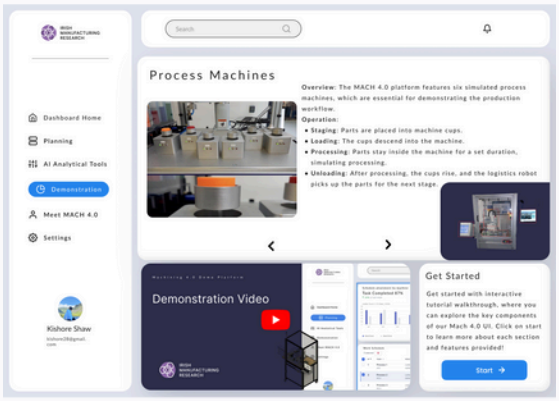


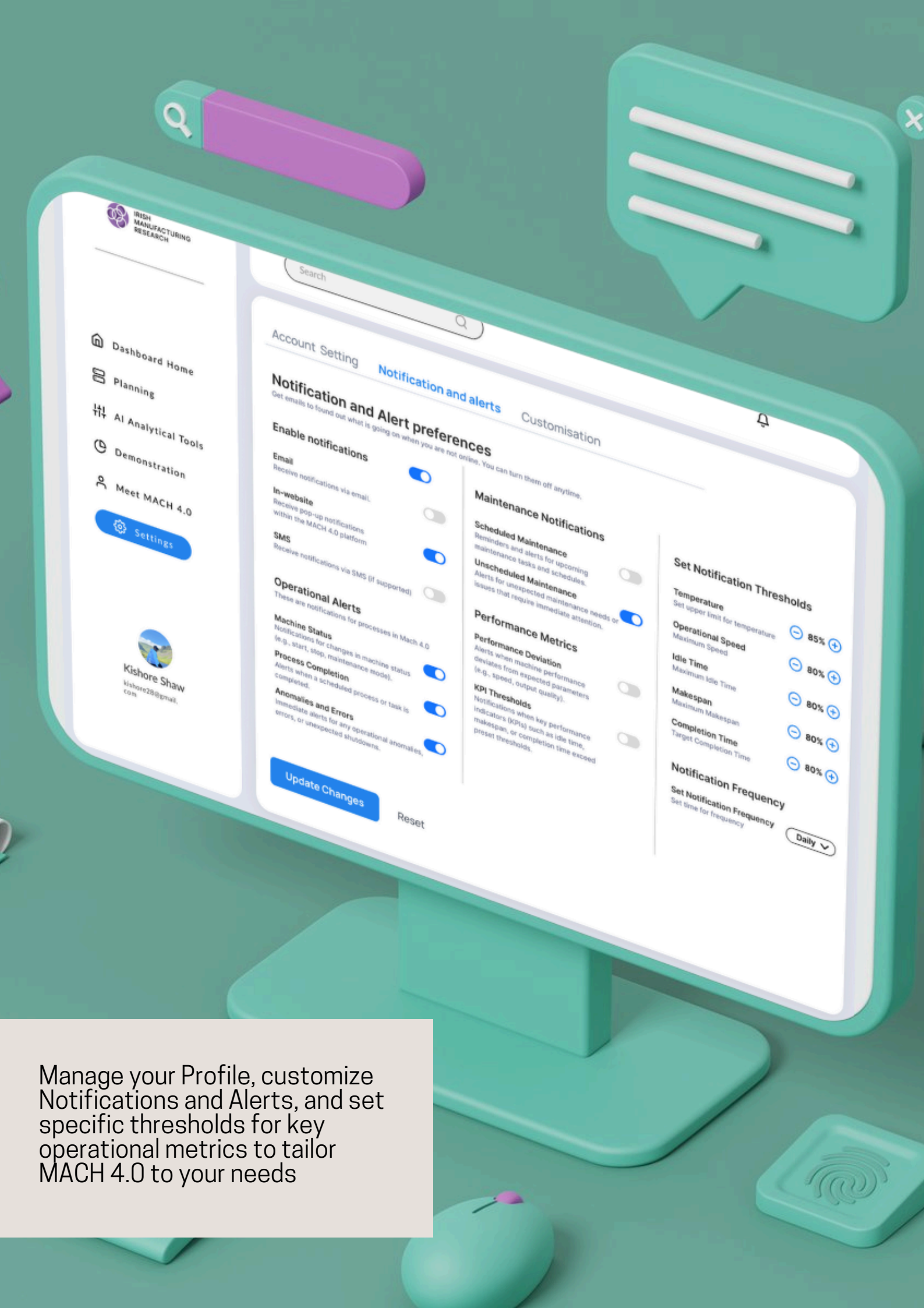




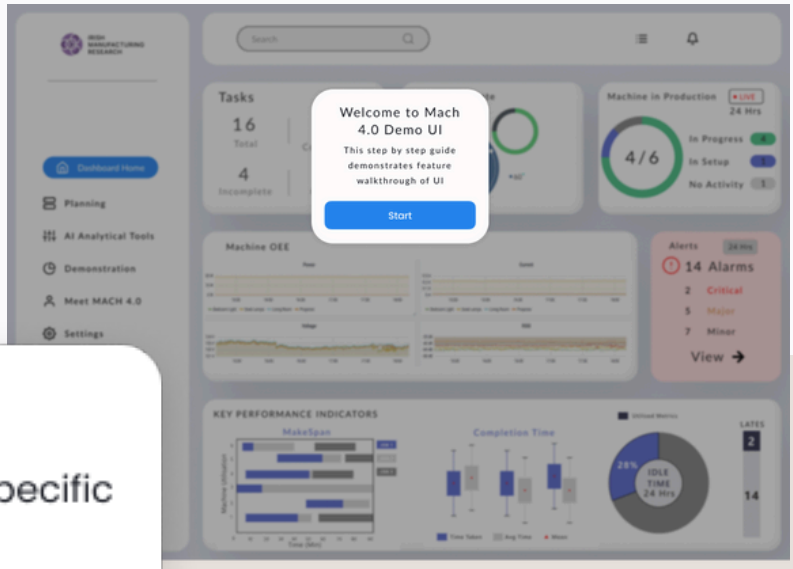








Manage your Profile, customize Notifications and Alerts, and set specific thresholds for key operational metrics to tailor MACH 4.0 to your needs

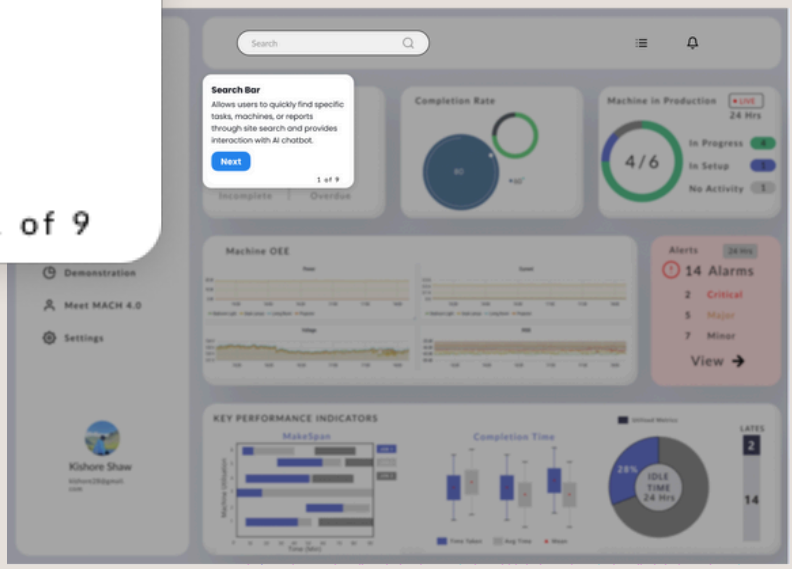


Search Bar

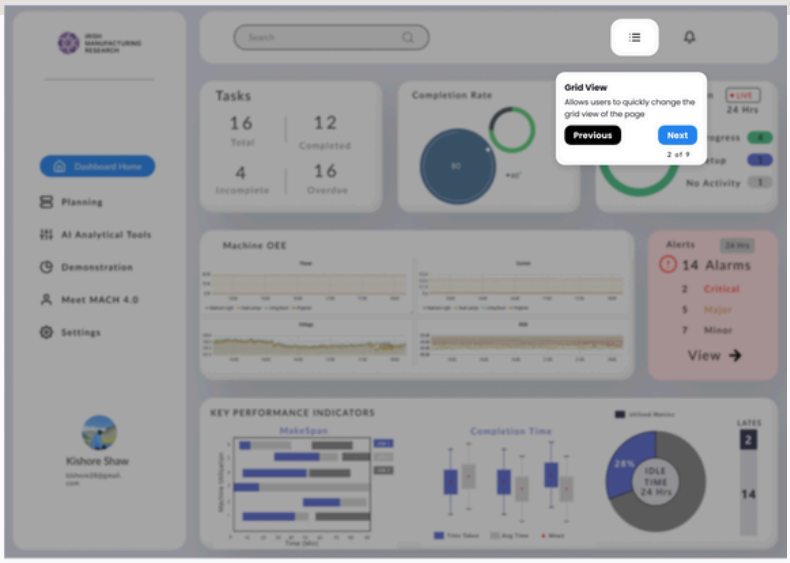
Allows users to quickly find specific tasks, machines, or reports through site search and provides interaction with AI chatbot.

Next

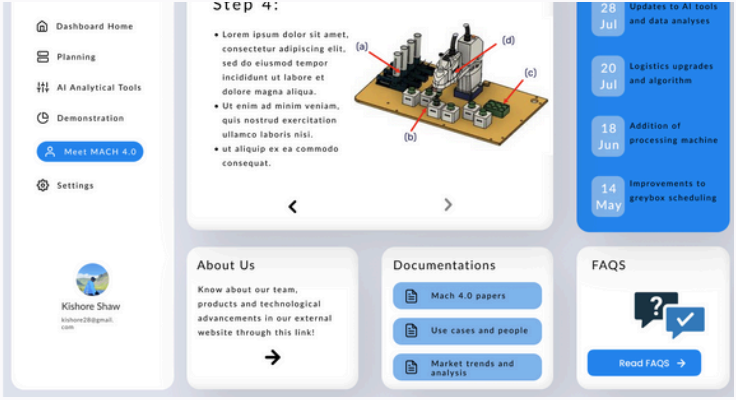
1 of 9

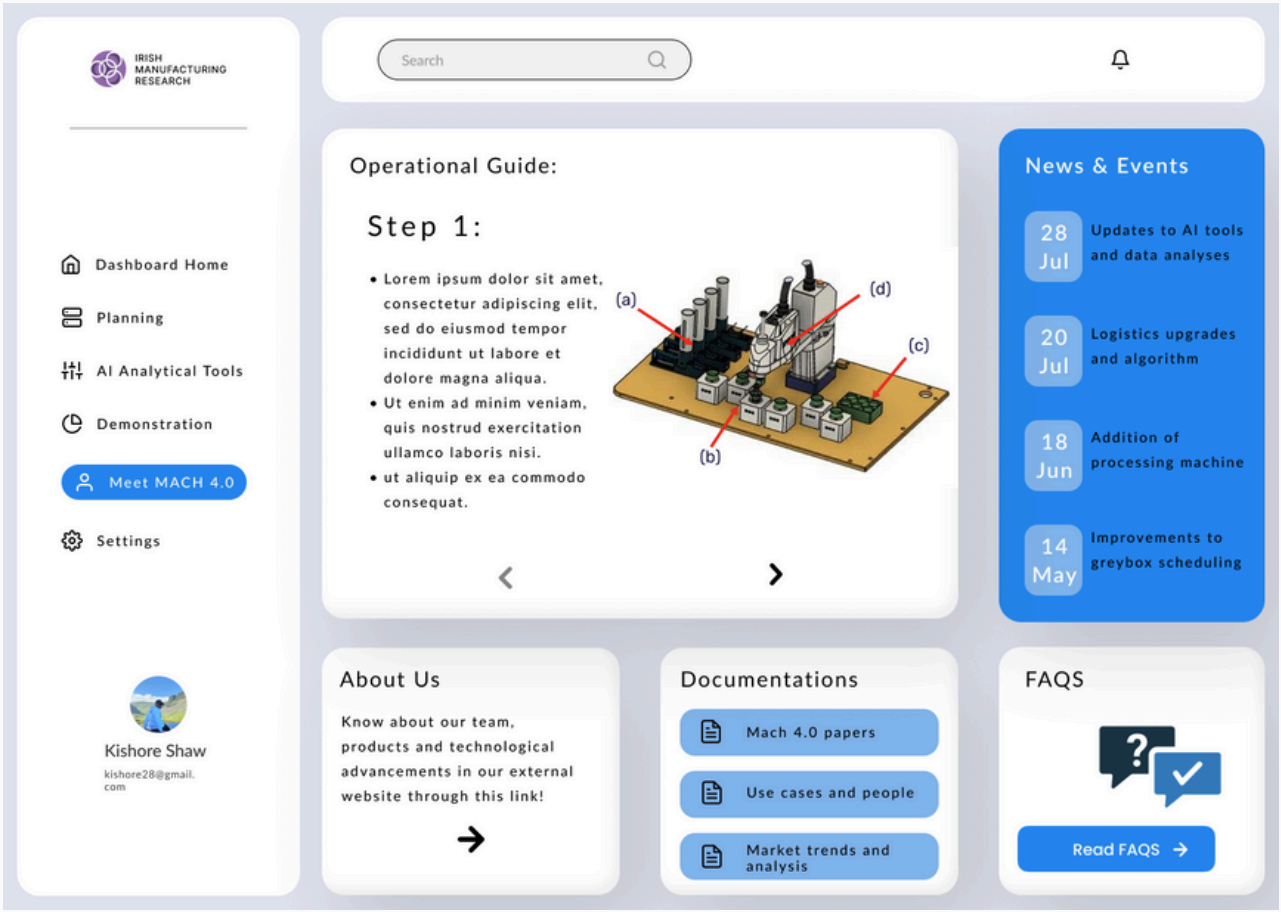


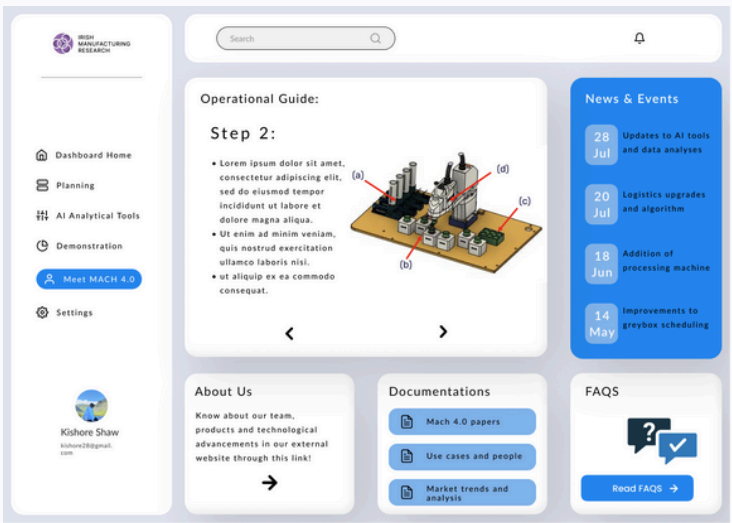
Get started button provides access to explore MACH 4.0 user interface step by step, with hands-on guidance through each feature and section, ensuring a seamless onboarding experience.



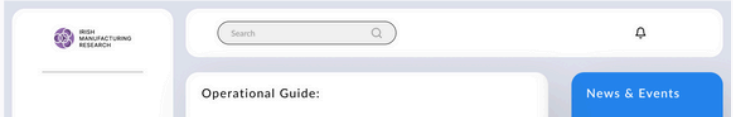
Meet MACH 4.0 page







Discover MACH 4.0 with operational guide, stay updated with News and Events, find answers in the FAQs, access in-depth Documentation of projects, and learn more About machining platform—all in one place.



REFLECTION ON THE FINAL DESIGN

Reflection on the Final Solution

The final solution for the Mac 4.0 platform represents the culmination of extensive research, design iterations, and collaborative effort. My involvement in this phase was deeply hands-on, particularly in implementing the Computer User Interface (UI) and structuring the Human-Machine Interface (HMI). This experience not only solidified my understanding of user-centered design but also significantly enhanced my technical skills in using industry-standard tools like Adobe XD, Figma, and Canva.

Designing the User Interface

Throughout the design process, I applied key design principles such as simplicity, consistency, and user-centricity. Using Adobe XD and Figma, I was able to create detailed mockups and prototypes that visually represented the functionality and flow of the UI. These tools were instrumental in allowing me to iterate quickly, incorporating feedback from stakeholders and testing different design ideas in real-time. Canva was also used for creating visual elements and ensuring that the aesthetic aspects of the interface aligned with the overall design philosophy.

Prototyping and Iteration

Figma played a crucial role in prototyping the UI frames, enabling me to build interactive prototypes that could be tested and refined based on user feedback. This hands-on experience with prototyping not only improved the fidelity of the final design but also deepened my understanding of how users interact with the interface, leading to more intuitive and efficient designs.

Structuring the HMI

In addition to UI design, I contributed significantly to the HMI structuring. This involved ensuring that the physical controls and displays of the Mac 4.0 machinery were closely aligned with the digital interface, creating a seamless user experience. By applying consistent design logic between the HMI and UI, I was able to reduce the learning curve for users and minimize the potential for operational errors.

Learning and Growth

This project was a significant learning experience for me, especially in mastering design tools like Adobe XD, Figma, and Canva. It also reinforced the importance of adhering to design principles and iterative testing to create a product that truly meets user needs. Through this process, I gained a deeper appreciation for the complexities of interface design and the critical role of prototyping in refining and perfecting the final solution.

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APPENDIX

Interviewer: The goal of this interview is to gain insights into the current functionality of the Mac 4.0 platform and identify areas where interaction can be enhanced using advanced technologies such as MLMs (Machine Learning Models). Your input will be valuable for shaping the improvements we plan to implement. Before we start with the formal questions, I want to mention that we have attached two documents in the email regarding expenditure information and information usage. We need you to fill those out and submit them to the ethics committee to ensure that the provided information is not misused.

Interviewee: Okay, I'll handle that. Could you send the files via email as well?

Interviewer: Sure, we'll include the files in the main tab so that you can be added as a recipient.

Interviewee: Okay, let's proceed with the interview.

Interviewer: Is this interview going to be one-on-one, or will both of you be participating?

Interviewee: Yes, it's better if it's one-on-one. I'll step out and rejoin once the interview is done. That way, you can have a focused conversation.

Interviewer: That works. Let's start with the background information. Can you please describe your role in the development of the Mac 4.0 platform?

Interviewee: I was an engineer mainly handling programming, electronics, and integration elements. We had a team of three people: a mechanical engineer who handled mechanical aspects, and I took care of pneumatics, PLC programming, sensor and robot integration, and ensuring the PLC programs were functioning correctly. I also helped with some robot programming and addressed issues in the robot application when necessary. On the hardware side, I managed the selection and configuration of sensors, PLCs, and power supplies, as well as the overall design and integration from the ground up. Once the initial hardware setup was complete, I was involved in integrating data analytics algorithms with the platform, ensuring the optimization algorithm could interact with the machine setup, and facilitating communication between the PLC and other components.

Interviewer: That's quite comprehensive. Could you provide an overview of the main functionalities of the Mac 4.0 platform, just in bullet points?

Interviewee: The main functionality is the demonstration of various scheduling algorithms deployed on a small-scale simulated factory setup. This includes six different machines, a logistics system, and four separate workpiece streams. The robot transports workpieces between the machines, and the system handles the scheduling and execution of these tasks until completion. The demo showcases how different scheduling algorithms can be applied in a manufacturing environment.

Interviewer: How does the Mac 4.0 platform contribute to the manufacturing sector? What specific problems does it solve?

Interviewee: The demo rig serves two primary purposes. First, it is used to demonstrate to potential clients who visit our site at IMR. These clients often face various challenges in their manufacturing processes, and the demo helps them understand how scheduling, data integration, and automation can be applied to solve their problems. Second, we also take this rig to trade shows to showcase IMR's capabilities in addressing complex scheduling and optimization issues. The platform highlights the complexity of scheduling problems and the potential solutions that can be applied across different manufacturing environments.

Interviewer: Can you describe a typical user interaction scenario with the platform? How do users or stakeholders currently interact with it?

Interviewee: Typically, we don't allow customers to operate the machines themselves due to the complexity and the specific sequence required to run the demo. Either myself or a colleague will run the demo, setting up the factory floor by resetting the machines and ensuring everything is in the correct starting position. Once the setup is complete, we run the demo, explaining the various aspects of the platform as it operates. We can simulate different scenarios, such as machine failures, and demonstrate how the scheduling algorithm adapts in real-time. The entire demo cycle usually lasts around 15 minutes, after which the machine needs to be reset for the next demonstration.

Interviewer: What feedback have you received regarding the demo? Are there any common strengths or criticisms?

Interviewee: One of the main limitations is that the demo requires some expertise to operate, so we can't just leave it unattended for people to explore on their own. Also, the demo doesn't reset itself automatically after each cycle, so we need to manually prepare it for the next run. Another issue is that the user interface is not very intuitive for first-time users, and we have tried to mitigate this by adding explanatory stickers on the machine. However, these stickers are often overlooked, so there is still a lack of clarity in what the demo is showing. Ideally, users should be able to understand what's happening within a few seconds without needing detailed explanations.

Interviewer: Regarding the data aspect, what types of data are collected, analyzed, and visualized by the gray box system?

Interviewee: We collect data on the status of the robots, machines, and feeders, as well as task statuses like loading, processing, idle, and maintenance. The system also tracks the scheduling information, such as task IDs, start and end times, and task priorities. This data is used to monitor the system's performance and can be visualized to show the current state of the factory floor, task execution timelines, and machine utilization. The data is primarily used for internal analysis, but it can also be exported for further processing.

Interviewer: Given the current setup, what additional features or improvements do you think would benefit the platform?

Interviewee: Improving the user interface would be a priority to make it more intuitive and easier for new users to operate the demo. Also, automating the reset process after each demo cycle would be beneficial. Additionally, integrating more advanced analytics and AI-driven optimization features could provide deeper insights and better decision-making tools for users.

Interviewer: Are there any limitations or challenges you foresee in implementing these features or integrating various forms of data?

Interviewee: One major limitation is the communication protocol supported by our current PLC, which doesn't allow for subscription-based data reads. This means we have to poll the PLC for updates, which can lead to missed events or data inaccuracies, especially with fast-moving operations. Upgrading to a more modern PLC with better communication capabilities would be a significant improvement.

Interviewer: Finally, are there any security concerns or additional insights you would like to share about the platform?

Interviewee: In terms of security, there aren't significant concerns since it's just a demo setup, but connectivity is a challenge. Currently, we rely on Ethernet cables for connectivity, which isn't ideal when moving the rig to different locations. Upgrading to a wireless connection would be a better solution. Overall, the demo platform is a valuable tool for showcasing our capabilities, but there's room for improvement in terms of automation, usability, and data integration.

Interviewer: Thank you for your time and insights. We've gained a lot of valuable information from this interview. If we have any follow-up questions or need further clarification, we'll reach out.

Interviewer: The goal of this interview is to gain insights into the current functionality of the Mac 4.0 platform and identify areas where interaction can be enhanced using advanced technologies such as MLMs (Machine Learning Models). Your input will be valuable for shaping the improvements we plan to implement. Before we start, I want to let you know that we've attached two documents in the email regarding expenditure information and information usage. We need you to fill those out and submit them to the ethics committee to ensure proper handling of the information provided.

Interviewee: Okay, I'll take care of that. Could you also send the files via email?

Interviewer: Sure, we'll include the files in the main tab so that you can be added as a recipient.

Interviewee: Alright, let's move on to the interview.

Interviewer: For this interview, is it going to be a one-on-one session, or will both of you be participating?

Interviewee: One-on-one is probably better. I'll step out and rejoin once the interview is done so you can have a focused discussion.

Interviewer: That works. Let's begin with some background information. Could you please describe your role in the development of the Mac 4.0 platform?

Interviewee: I was an engineer primarily responsible for programming, electronics, and integration. We had a team of three, including a mechanical engineer who handled the mechanical aspects. My role involved working on pneumatics, PLC programming, and integrating sensors and robots, ensuring the PLC programs were functioning correctly. I also assisted with some robot programming and addressed issues as they arose. My tasks also included selecting and configuring sensors, PLCs, and power supplies, and overall ground-up design and integration. After the initial hardware setup, I was involved in integrating data analytics algorithms, ensuring that the optimization algorithms could interact with the machine setup and communicate between the PLC and other components.

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Interviewer: Thank you for your time and insights. We've gained a lot of valuable information from this interview. If we have any follow-up questions or need further clarification, we'll reach out.

Interviewee: No problem, feel free to contact me if you need anything else. Good luck with your project.

Interviewer: Thank you, and have a great day!

LINKS:

https://www.figma.com/proto/M9WmMCYdgO27Oj3JzC03l0/Portfolio?page-id=155%3A2&node-id=266-5934&viewport=-1301%2C-1492%2C0.11&t=qwQXLZsdzF5xVca8-1&scaling=scale-down&content-scaling=fixed&starting-point-node-id=266%3A5934&show-proto-sidebar=1

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