IMMERSIVE POWERPLANT CONFIGURATION: DESIGNING FIRST TIME USER EXPERIENCE FOR INDUSTRIAL METAVERSE

A PROJECT REPORT

SUBMITTED IN PARTIAL FULFILLMENT
OF THE REQUIREMENTS
FOR THE AWARD OF THE DEGREE

MASTER OF DESIGN
IN
INTERACTION DESIGN

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CANDIDATE'S DECLARATION

I, **Isha Aggarwal, Roll No. 2K21/MDID/07** student of **M.Des. Interaction Design**, hereby declare that the project Dissertation titled "**First Time User Experience for Industrial Metaverse"** which is submitted by me to the Department of Design, Delhi Technological University, Delhi in partial fulfillment of the requirement for the award of the degree of Master of Design, is original and not copied from any source without proper citation. This work has not previously formed the basis for the award of any Degree, Diploma Associateship, Fellowship or 'recognition. other similar title or recognition.

Place: Delhi   Isha Aggarwal

Date: 25 May 2023

CERTIFICATE

I hereby certify that the Project Dissertation titled “**Designing First Time User Experience For Industrial Metaverse**" which is submitted by **Isha Aggarwal, Roll No. 2K21/MDID/07 Department of Design (Interaction Design)**, Delhi Technological University, Delhi in partial fulfillment of the requirement for the award of the degree of Master of Design, is a record of the project work carried out by the students under my supervision. To the best of my knowledge this work has not been submitted in part or full for any Degree or Diploma to this University or elsewhere.

Place: Delhi

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ABSTRACT

The project aims to design a seamless and engaging first-time user experience (FTUX) for an industrial metaverse, which is a virtual environment that simulates real-world industrial processes and enables collaboration and training in a digital space. The focus of the project is to design an experience that guides users through the onboarding process and introduces them to the various features and functionalities of the metaverse and let them complete their tasks successfully.

To achieve this goal, the project will employ a innovation-driven design approach, which involves conducting vast secondary research, ideation creating storyline, and prototyping the design. The research will involve gathering insights into the needs, goals, and pain points of users who are new to industrial metaverse technology, as well as identifying best practices and design frameworks from the research.

The resulting design will incorporate visual and interactive elements that are easy to understand and use, such as tooltips, guides, and contextual help, assistants etc. The design will also consider personalisation, taking into account the needs of users, and their role & responsibility concerning industrial metaverse.

Overall, the project aims to create an FTUX that reduces user frustration and confusion, increases engagement and retention, and ultimately contributes to the adoption and success of industrial metaverse technology for users who are visiting first time.

Industrial metaverse are complex virtual environments that simulate real-world industrial processes, and users who are new to this technology may be overwhelmed by the sheer amount of information and options available to them. Therefore, the design must strike a balance between providing enough guidance and information to help users navigate the metaverse and accomplish their goals, without overwhelming them with too much information.

To achieve this balance, the design process will involve a thorough analysis of user & company’s goals, as well as an exploration of existing virtual environments and design patterns and incorporate new patterns.

ACKNOWLEDGEMENT

No project is ever complete without the guidance of teachers & experts and hence, I would like to take this opportunity to take all those individuals who have guided me in designing this project.

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CHAPTER 1

INTRODUCTION

1.1 Metaverse

The Metaverse represents a technological concept that is reshaping the way we interact, communicate, and engage with digital spaces, enabling a new era of immersive experiences and social connectivity. The Metaverse, is portrayed as a virtual universe or a collective shared space, which transcends the boundaries of traditional virtual reality and offers a seamless integration of physical and digital realms. As technology continues to advance, the Metaverse has emerged as a transformative concept that holds immense potential across various sectors, including entertainment, gaming, education, commerce, and social networking.

By leveraging augmented reality, virtual reality, artificial intelligence, and blockchain technologies, the Metaverse creates an interconnected network of digital environments where users can interact with each other and with computer-generated entities in real-time. These environments are not limited to visual experiences alone; they can engage multiple senses, incorporating haptic feedback, spatial audio etc.

1.2 Industrial Metaverse

An industrial metaverse is a virtual environment that simulates real-world industrial processes and operations. It is a type of metaverse specifically designed for industrial work.

Fig1.1: Depiction of Industrial Metaverse

It is often used in industries such as manufacturing, energy, and transportation. Industrial metaverse can be accessed through virtual reality or augmented reality devices, which allow users to interact with virtual objects and environments as if they were physically present. These virtual environments can be highly complex, incorporating a wide range of tools, machines, and processes that require specific skills and knowledge to operate effectively. By providing a safe and controlled environment for training and collaboration, industrial metaverse can help improve safety, efficiency, and productivity in industrial settings.

With the advent of virtual reality and augmented reality technologies, industrial metaverse have become an increasingly popular tool for training and collaboration in industrial settings. These virtual environments simulate real-world industrial processes and enable users to practice and refine their skills in a safe and controlled environment. However, the complexity of these virtual environments and the range of features and functionalities they offer can pose a challenge for first-time users.

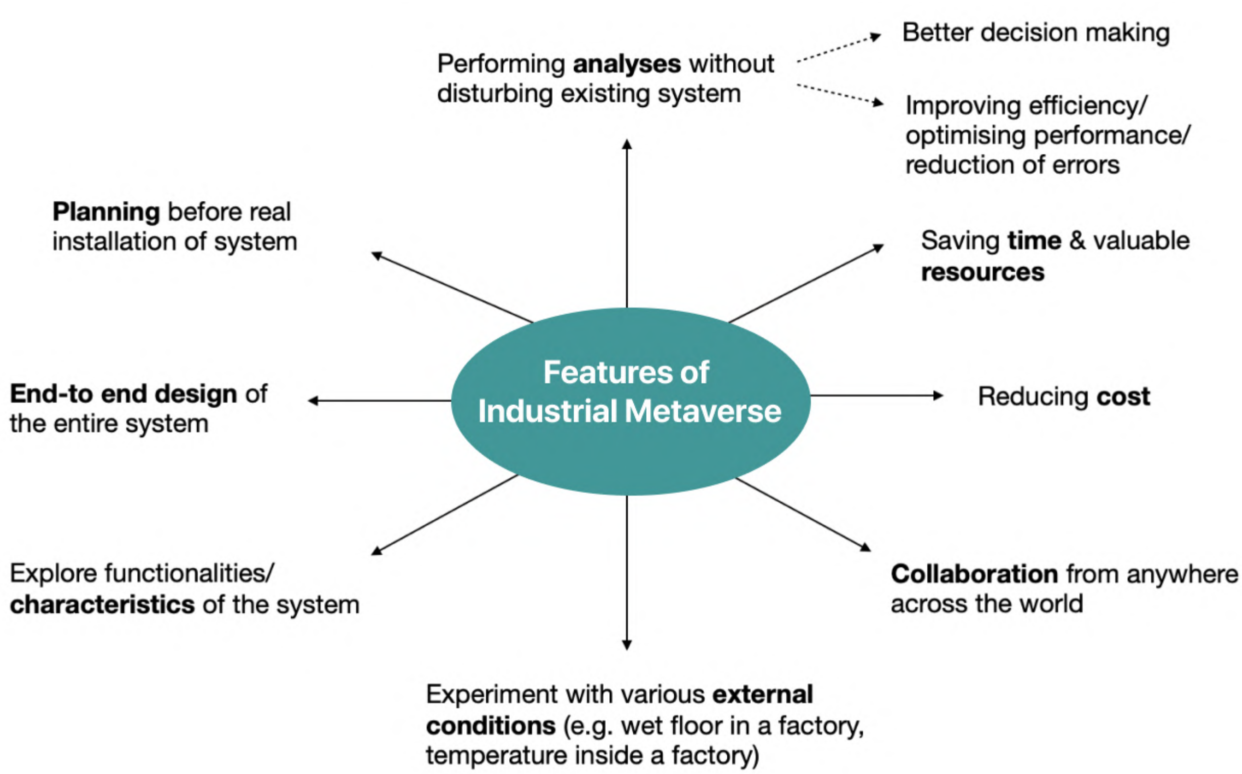


Fig 1.2: Features of Industrial Metaverse

1.3 Components of Industrial Metaverse

Components of Industrial Metaverse are its pillars which helps in creating seamless, experience for users entering into metaverse.

1.3.1 Immersion

Immersion in the Metaverse refers to the state of complete engagement and absorption experienced by users within virtual environments. It involves the ability of the technology and design of the Metaverse to create a sense of presence and to make users feel as though they are truly immersed in the digital world.

The level of immersion can vary depending on the sensory stimuli provided by the Metaverse, such as realistic visuals, spatial audio, haptic feedback, and interactive elements. When these elements combine seamlessly, users can suspend disbelief and experience a heightened sense of being present in the virtual environment.

Immersion goes beyond mere visual and auditory experiences. It encompasses the feeling of agency and interactivity, allowing users to actively engage with the virtual world and influence its outcomes. This can involve manipulating objects, interacting with other users and virtual entities, and participating in dynamic and responsive experiences.

Moreover, immersion in the Metaverse extends to the social dimension, as users can interact and communicate with others in real time, forming connections and building relationships within the virtual environment. This social immersion adds a layer of depth and realism to the experience, enhancing the sense of being part of a vibrant and interconnected community.

Overall, immersion in the Metaverse is about creating an all-encompassing and captivating experience that blurs the boundaries between the physical and digital realms, enabling users to fully engage, explore, and interact within the virtual world.

1.3.2 Interaction

Interaction in the Metaverse refers to the active engagement and communication between users and the virtual environment, as well as between users themselves. It involves the ability for individuals to manipulate objects, navigate spaces, and engage in dynamic exchanges within the digital realm.

In the Metaverse, interaction can take various forms, ranging from simple gestures and movements to complex actions and decision-making processes. Users may utilise controllers, motion tracking devices, or even body movements to interact with the virtual environment and trigger specific responses. This can include actions such as picking up and moving objects, manipulating virtual tools, or engaging in physical activities within virtual simulations.

Furthermore, interaction in the Metaverse extends beyond individual experiences. Users can interact and collaborate with other participants in real-time, creating social connections, engaging in cooperative activities, or competing in virtual games and challenges. Communication tools such as voice chat, text chat, and avatar gestures enable users to communicate, coordinate, and express themselves within the shared digital space.

The level of interaction within the Metaverse can vary depending on the design and capabilities of the virtual environment. Advanced technologies like artificial intelligence and natural language processing can enhance interaction by allowing users to engage in more natural and intuitive ways, such as conversing with virtual characters or issuing voice commands.

Ultimately, interaction in the Metaverse plays a vital role in shaping the user experience and enabling meaningful engagement within the virtual world. It fosters a sense of agency, social connection, and empowerment, empowering users to actively shape and participate in their virtual experiences.

1.3.3 Collaboration

Collaboration in the Metaverse refers to the cooperative and interactive efforts of multiple users within virtual environments to achieve shared goals, create content, or solve problems. It involves the ability for individuals to work together in real-time, leveraging the capabilities of the Metaverse to enhance communication, coordination, and collective action.

In the Metaverse, collaboration can take various forms, depending on the context and purpose. It can involve users collaborating on creative projects, such as designing virtual spaces, creating artwork, or developing virtual experiences. Collaborative gaming experiences, where players join forces to overcome challenges or compete against others, are also common in the Metaverse. The Metaverse provides tools and features that facilitate collaboration, such as shared virtual workspaces, real-time communication channels, and interactive elements that enable users to contribute and interact with each other's work. Users can engage in tasks simultaneously, share resources, exchange ideas, and provide feedback, fostering a sense of shared ownership and teamwork.

Collaboration in the Metaverse goes beyond geographical limitations, allowing individuals from different locations to connect and work together seamlessly. This enables diverse perspectives and expertise to come together, promoting innovation, problem-solving, and knowledge sharing.

Furthermore, the Metaverse can support professional collaboration, enabling remote teams to collaborate on projects, conduct virtual meetings, and engage in virtual conferences. This not only enhances productivity but also promotes inclusivity and accessibility, as individuals from various backgrounds and abilities can participate and contribute.

Overall, collaboration in the Metaverse empowers users to harness the collective intelligence, creativity, and skills of a distributed community. It offers new opportunities for cooperation, co-creation, and social interaction, fostering a sense of collective achievement and unlocking the potential for transformative collaboration in digital spaces.

1.4 Digital Twin

In the context of the industrial metaverse, a digital twin refers to a virtual replica or representation of a physical object, process, or system within the digital realm. It serves as a digital counterpart that mimics the physical characteristics, behaviour, and performance of its real-world counterpart.

The concept of a digital twin is based on the idea of bridging the gap between the physical and digital worlds, enabling real-time monitoring, analysis, and control of physical assets and processes through their virtual counterparts. The digital twin incorporates data from sensors, IoT devices, and other sources to simulate and mirror the behavior, functionality and status of the corresponding physical object or system.

In the industrial metaverse, digital twins find application in various sectors, such as manufacturing, energy, transportation, and infrastructure. They allow for improved understanding, optimisation, and decision-making by providing real-time insights and analysis of the physical assets or processes they represent. By leveraging the capabilities of the digital twin, industrial organisations can perform virtual simulations, predictive maintenance, and scenario testing, leading to more efficient operations. The digital twin also enables remote monitoring and control, facilitating the management of complex systems and enhancing safety and productivity.

Furthermore, digital twins in the industrial metaverse facilitate collaboration and knowledge sharing. Multiple stakeholders, such as engineers, operators, and maintenance personnel, can access and interact with the digital twin to contribute their expertise, conduct virtual inspections, and collaborate on problem-solving. Overall, digital twins in the industrial metaverse play a pivotal role in enabling the integration of physical and digital systems. They enhance visibility, analysis, and control of industrial processes, enabling organisations to optimise operations, improve productivity, and drive innovation in a dynamic and interconnected digital environment.

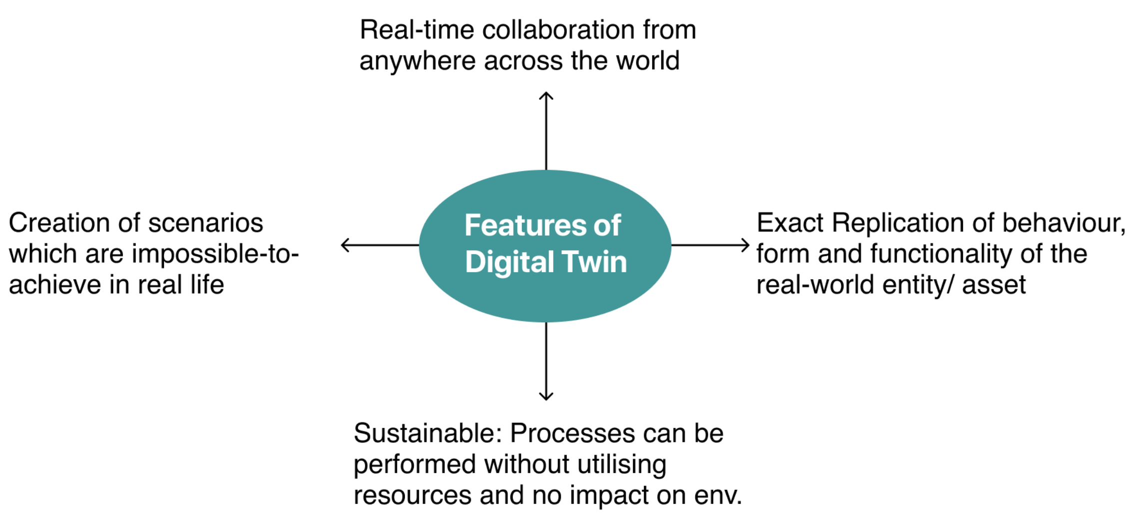


Fig 1.3: Features of Digital Twin

1.4.1 Classification of Digital Twin

Digital Twin is classified into mainly two groups: data-driven digital twin and Model-driven digital twin

a. Data-Driven Digital Twin

A data-driven digital twin is an analytic model constructed using sensor data taken from the plant's operation. It is a representation of the physical relationship among plant variables and is constructed without the inclusion of first-principles models.

b. Model-Driven Digital Twin

A model-driven digital twin uses existing data about the form & functionality of the physical asset to predict the outcomes in various use-case scenarios.
In this project, focus is on model driven digital twin. The Model-Driven Digital Twin accurately captures the physical attributes, functional capabilities, and operational dynamics of the real-world asset or system. This model serves as the foundation for creating a Industrial metaverse environment. By incorporating real-time data from sensors, IoT devices, and other sources, the Model-Driven Digital Twin can continuously update and refine its digital model to reflect the current state and conditions of the physical asset or system.

1.5 Use of Extended Reality Technology in Industrial Metaverse

1.5.1 Augmented Reality

Augmented reality (AR) refers to the technology that overlays digital information, such as virtual objects, images, audio, video, data, or visualisations, onto the real-world environment in real-time. It enhances the perception and understanding of the physical world by superimposing digital elements onto it, thus blending the virtual and real worlds together.

In the industrial metaverse, augmented reality can be used to provide workers with real-time contextual information, instructions, and guidance during industrial operations. By wearing AR-enabled devices, such as smart glasses or headsets, workers can view digital overlays that augment their field of vision, offering insights, data, and visualisations related to their tasks. Moreover, AR in the industrial metaverse facilitates remote collaboration and expert assistance. Workers can share their AR-view with remote colleagues or experts who can provide guidance, troubleshoot issues, and offer real-time support, regardless of geographical distance. This capability enhances knowledge sharing, accelerates problem-solving, and reduces the need for on-site visits.

By leveraging AR in the industrial metaverse, organisations can enhance productivity, improve safety, and streamline operations. It empowers workers with real-time information, guidance, and remote support, enabling them to perform tasks more efficiently, effectively, and with higher confidence in complex and dynamic industrial environments.

1.5.2 Mixed Reality

Mixed reality (MR) refers to a technology that combines elements of both virtual reality (VR) and augmented reality (AR) to create a seamless blend of the digital and physical worlds. It allows users to interact with virtual objects and digital information while maintaining awareness and presence in the real-world environment.

By wearing MR devices, such as headsets or glasses, workers can perceive and manipulate virtual objects that are integrated into their real-world surroundings.

One of the key advantages of mixed reality in the industrial metaverse is its ability to enable realistic and immersive simulations. Workers can interact with virtual replicas of machinery, equipment, or entire factory layouts, allowing them to train, test, and optimise processes in a virtual environment before implementing them in the real world. This helps to minimise risks, improve efficiency, and reduce costs associated with physical prototyping or testing.

Mixed reality also facilitates collaborative work by allowing multiple users to view and interact with the same virtual objects simultaneously. Workers can collaborate remotely, sharing a mixed reality experience and working together on complex tasks or projects, regardless of their physical locations. This enhances communication, coordination, and knowledge sharing among team members.

1.6 Experience Stacks and Patterns for Industrial Metaverse

User Experience Stack & Patterns

Understandability *(Being aware of task/ context)*	**Usability** *(Ease of use)*	**Convenience** *(Eliminate physical and cognitive barriers)*	**Dependability/ Reliability** *(Always available accurate and meet goals)*	**Value/ Distinctivity** *(Distinguished, Uniqueness and beneficial)*
• Situation Awareness • Asset Visualisation • Context Setting	• Data Visualization • Sensory Guidance • Personalization	• Multiuser Collaboration • Contextual Dashboard • Cognitive Companion	• Traceability • Transparency • Integrity	• Temporal Visualization • Intelligent Interaction • Gamification

Fig 1.4: User Experience Stack & Pattern (Source: Siemens)

CHAPTER 2:
UNDERSTANDING THE PROBLEM:
SIEMENS ENERGY USE-CASE

2.1 Immersive product configuration of power plants

Designing a power plant is a complex & lengthy process which involves decision-making from multiple stakeholders about level of investment, capacity, environmental impact and other requirements. After getting understanding of all the attributes, an accurate configuration is gradually designed by salesperson. The real-time visual configuration improves the process of finding optimal solution, and reduces the chances of errors. Working in an immersive setting allows real-time collaboration between stakeholders and each of them can share their expertise at the right time. Various features like real-time collaboration, multi attribute configuration, multi user access, real-time interaction, in immersive-setting overall enhances the quality of solution with less time & less chances of errors.

2.2 Problem identification in traditional approach

- Hard to capture stakeholder’s requirement at an early stage
- Unclear tender specifications and hence bad impact the competitive position
- Difficult to incorporate past lessons
- Difficult to predict accurate pricing
- Difficult to take risk management into account
- Complex stakeholder management process towards final design

2.3 Need of Industrial Metaverse for Power plant use case

- Customer engagement & acceptance at early stage
- Faster generation of a feasible, suitable and optimised solution

- Clarification of conflicting interest at an early stage, driving down risk budget and implementation schedules
- New orders leading to increased revenue
- Remote collaboration from anywhere across the world

2.4 Mapping stakeholders’ challenges & needs

	Persona	Challenges	Needs
1	**Salesperson**	Rigidity in capturing customer’s requirement & ways of presenting suitable solutions.	• Engage with customers at early stage • Understand customer requirement • Create matching offers including all the details like price, configuration, quote etc
2	**Customer**	Complexity in understanding specifications of components of power plant and discussing with stakeholders about different aspects.	• Understand the specification like (functionality & price) of product • Finalise technical & commercial details • Configure power plant specifications
3	**Engineer**	Difficult to give input at right time with respect to right context and collaborating with other experts.	• Provide technical knowledge • Assist in customization
4	**Commercial manager**	Difficulty to match costing with the configured component.	• Understand the pricing details • Match the costing • Give approval, rejection & suggestions

Table 2.1: Mapping stakeholders’ challenges & needs

CHAPTER 3:
DESIGNING FOR FIRST TIME USERS

3.1 Importance of First Time User Experience

The first-time user experience (FTUE) plays a critical role in determining how users perceive and engage with the metaverse. If the FTUE is confusing or overwhelming, users may quickly become frustrated and abandon the technology altogether. Therefore, designing an intuitive and engaging FTUE is crucial for the success of industrial metaverse technology.

This project aims to address this challenge by designing a seamless and intuitive FTUE for an industrial metaverse. The project will employ a user-centred design approach, which involves conducting user research, creating user personas and flows, and prototyping and testing the design with potential users. The resulting FTUE will incorporate interactive and visual elements that guide users through the onboarding process and introduce them to the various features and functionalities of the metaverse.

Users may have different levels of familiarity with the new virtual environments, and may have different goals and expectations for using the metaverse. Hence, designing specific to new users' level of mental model is necessary.

User research mainly includes secondary research. Based on this research, the design team can create user personas and user flows, which are visual representations of the different types of users and their goals and actions within the metaverse.

3.2 Challenges first time users face in Metaverse

- Unawareness: User is unaware about functionalities of the system, navigation system of the environment, and intractable elements etc

- Complexity: Applications that are too complex can overwhelm users and make it difficult for them to understand how to use the application.

- Cognitive Load: Too many elements in the environment or options given to user overwhelms him and increases load on his working memory
- Lack of guidance: Users need guidance on how to use the application, including clear instructions, tooltips, and tutorials.
- Poor user interface: A poorly designed user interface can make it difficult for users to navigate the application and complete tasks.
- Technical issues: Technical issues such as slow loading times, crashes, and bugs can frustrate users and impact their overall experience.
- Lack of customization: Users may want to customise the application to meet their specific needs, and a lack of customization options can hinder their experience.
- Lack of feedback: Users need feedback on their actions within the application to understand whether they are making progress and completing tasks correctly.
- Limited accessibility: Applications that are not accessible to users with disabilities can exclude a significant portion of the population from the FTUE.

CHAPTER 4:
IDENTIFICATION OF RELEVANT USER EXPERIENCE STACK & PATTERNS

Relevant User Experience Stack & Patterns

Understandability *(Being aware of task/ context)*	**Usability** *(Ease of use)*	**Convenience** *(Eliminate physical and cognitive barriers)*	**Dependability/ Reliability** *(Always available accurate and meet goals)*	**Value/ Distinctivity** *(Distinguished, Uniqueness and beneficial)*
• Situation Awareness • Asset Visualisation • Context Setting	• Data Visualization • Sensory Guidance • Personalization	• Multiuser Collaboration • Contextual Dashboard • Cognitive Companion	• Traceability • Transparency • Integrity	• Temporal Visualization • Intelligent Interaction • Gamification

Fig 4.1: User Experience Stack & Pattern for FTUX

4.1 Understandability

Here, understandability refers to ability of understanding something or being aware of the task or context given.

4.1.1 Context Setting

Context is the surroundings, circumstances, environment, background or settings that clarify the meaning of an event that is happening or will happen. It gives understanding of the intent. In order for users to feel fully immersed in the virtual environment, they must feel that their actions and interactions are meaningful and have a purpose. Context setting can involve a variety of strategies, such as providing clear goals and objectives, establishing a consistent narrative or storyline, and creating a sense of community and social interaction. For example, in a social metaverse, context setting might involve creating virtual spaces that are designed to encourage interaction and socialization, such as virtual cafes or game rooms. In an industrial metaverse, context setting might involve creating scenarios that simulate real-world challenges and require specific skills and knowledge to solve. By creating a rich and engaging context for users to explore and interact with, metaverse designers can help create more meaningful and satisfying user experiences.

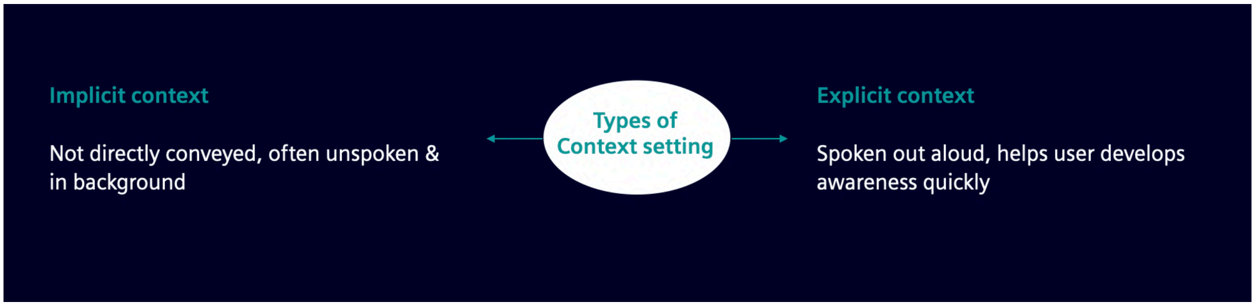


Fig 4.2: Types of Context setting

4.1.2 Situational Awareness

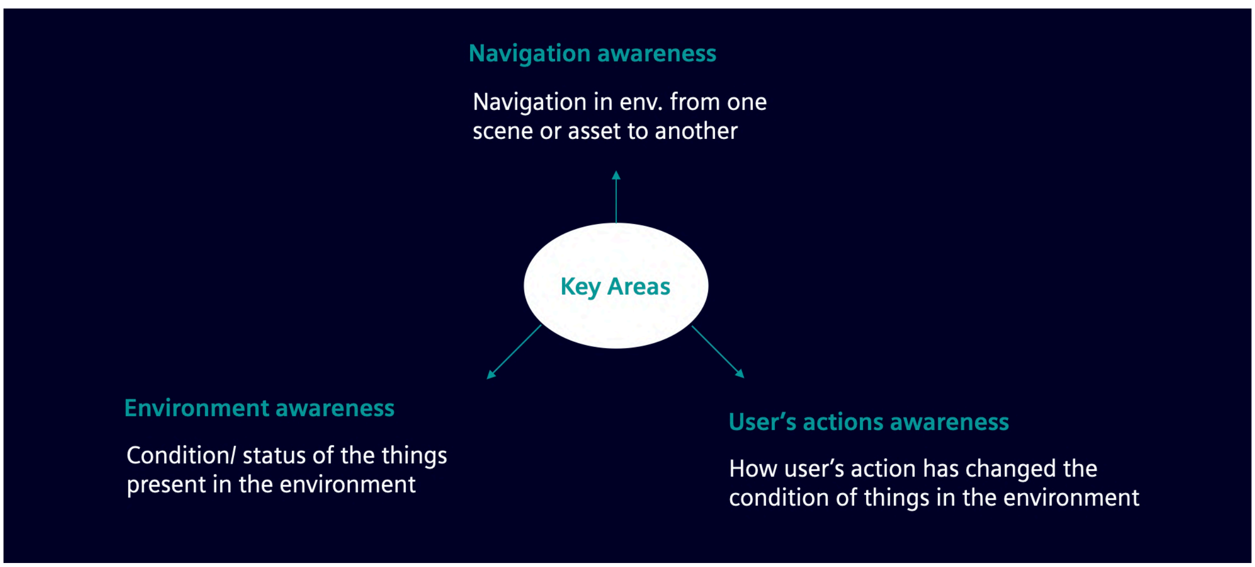


Fig 4.3: Key Areas of Situational Awareness

Situational awareness is a key element of success in any environment, including the metaverse. In the metaverse, situational awareness refers to a user's ability to understand their virtual surroundings, identify potential hazards or challenges, and make informed decisions based on that information. This can include a variety of factors, such as understanding the layout of a virtual environment, the behavior of other users or characters, and the goals and objectives of the metaverse experience. Situational awareness can be enhanced through a variety of strategies, such as providing clear visual cues and indicators, offering training and guidance on how to navigate the metaverse, and providing real-time feedback and alerts to help users stay aware of their surroundings. By promoting situational awareness in the metaverse, designers can help users feel more confident and in control of their virtual experiences, which can ultimately lead to more positive outcomes and greater engagement with the platform.

4.1.3 Asset Visualisation

Asset means any entity or simply an object. Asset visualization is a critical tool for managing and monitoring assets & their processes in the metaverse. In an industrial metaverse, users may need to interact with a variety of complex machinery and equipment, and asset visualization can help them understand how these assets work and how they are connected to one another. Asset visualization can take many forms, including 3D models, animations, and interactive simulations that allow users to manipulate and explore virtual assets in real-time. These visualisations can be used to provide users with real-time data and insights about machine performance and maintenance needs, as well as to help train and educate users on how to operate and maintain complex equipment. By providing users with a clear and intuitive way to understand industrial processes and equipment, asset visualization can help improve safety, efficiency, and productivity in industrial settings.

Fig 4.4: Key Areas for Asset Visualization

CHAPTER 5:
STORYLINE GENERATION & STORYBOARDING

5.1 Storyline

1. Need Generation Customer considers building the new Power Plant	**2. Presence of Siemens** Siemens Energy being a trusted partner offers a Metaverse platform where customer and other stakeholders can configure and explore the features of Power Plant.	**3. Introduction to Metaverse** Customer is introduced to the Metaverse, immersive devices and is given guidance to use them.	**4. Spawning into Metaverse** Customer enters into the Metaverse where he chooses his Virtual Avatar and meets Siemens representative.
5. Menu/ Offerings of Metaverse Customer is provided various offerings like configuring power plant, exploring configured power plant, visiting knowledge centre etc	**6. Exploration** Customer explores the offering and Considering customer's goal (e.g. configuring power plant) representative provides assistant to customer.	**7. Collaboration** Customer collaborates with Engineer, Specialist from across the globe in the Metaverse to take decision on the configuration of powerplant	**8. Updation** Configured power plant is analysed from different perspectives like environmental hazards, investment etc. Changes are made in real-time and improvised power plant is visualized.
9. Approval of offer Other stakeholders who gives approval for the building of power plant (e.g. Commercial manager) are made to experience the configured powerplant.	**10. Virtual to Real-life transformation** Configured 3D model of the powerplant in the Metaverse acts as the starting point/ blue-print for building the powerpoint in real-life		

Table 5.1: Basic Storyline

5.2 Storyboarding of the flow

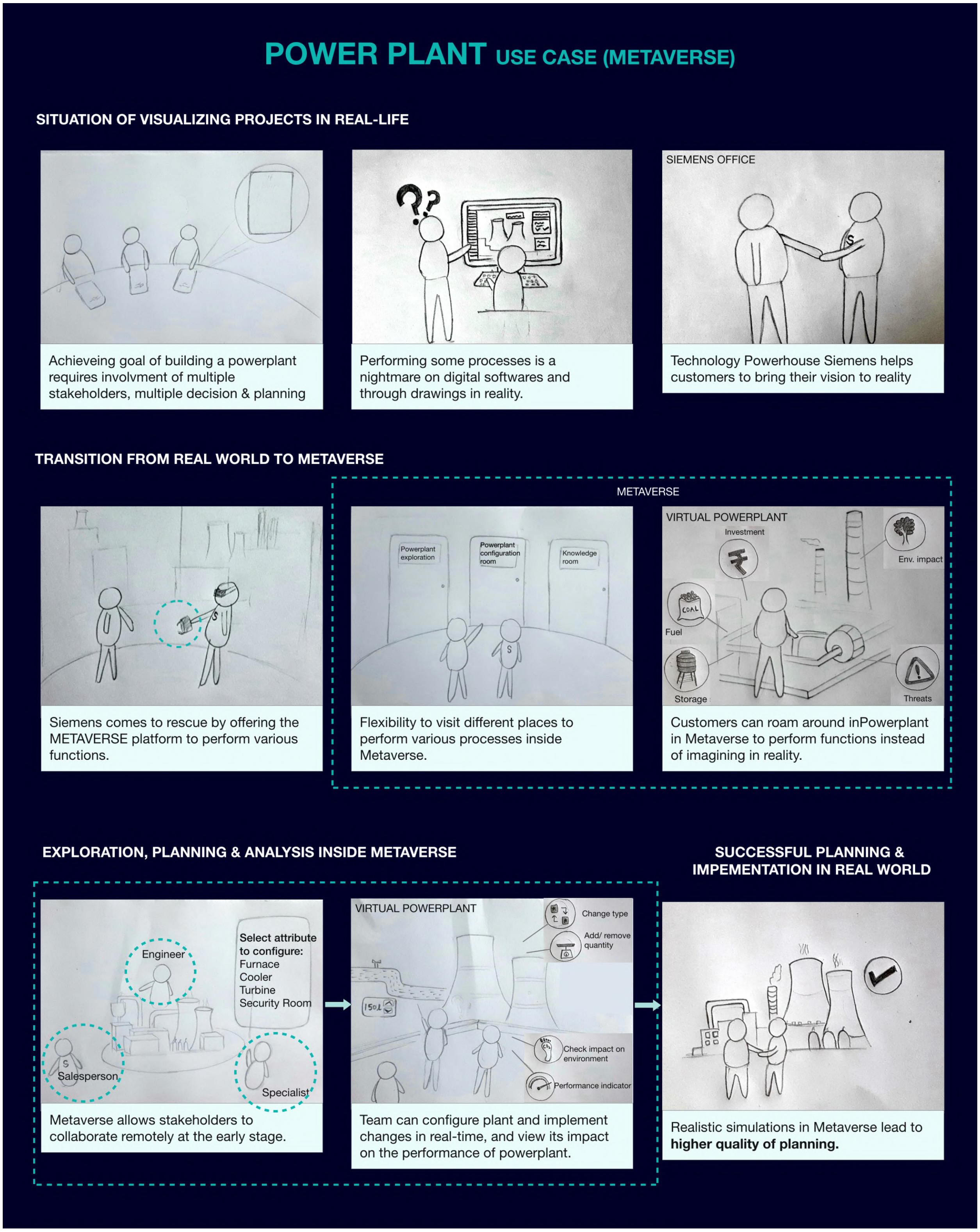


Fig 5.2: Storyboarding

5.3 Detailed Storyline Creation & Mapping it with experience

1. User onboarding

- Users see the environment
- Splash screen containing logo, textual content, micro animation etc appears in front of the user

2. Learning how to use Global menu controls

System informs user how to access and use global controls

User tries himself and learns

3. Viewing Digital Twin of Power plant

- User explores from outer level
- User learns to interact with the augmented information
- User interacts with the augmented information

4. Learning how to use local menu control

- System informs user how to access and use global controls

5. Navigating to inner component of Digital Twin

- User goes to inner components
- User understands working of inner components
- User interacts with the augmented information

6. Configuring parts of Power plant

- User sees augmented information
- User understand variables & selects desirable options
- User sees the change in the performance of Power Plant

7. User navigates to the outer level

• User views status of configuration

• User goes back to the outer level view

8.Final Inspection

• User views configured power plant

• User invites stakeholders for inspection

5.4 Understanding Power Plant Components

Some of the components of Power plant:

- Cooling Tower: A cooling tower removes heat by spraying water down through the tower to exchange heat into the inside of the building.
- Chimney: A chimney isolates hot toxic exhaust gases or smoke produced
- Condensor: A condenser is a vessel or stage which turns a vapor into a liquid
- Turbine: A turbine transforms rotational energy from a fluid into usable energy.

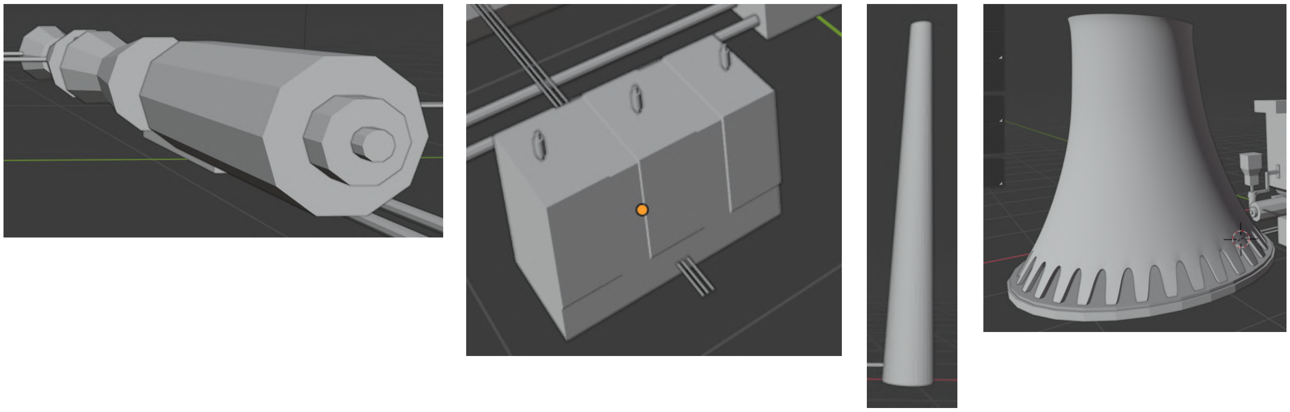


Fig 5.2: Parts of powerplant

5.5 Exploring Microsoft HoloLens Device

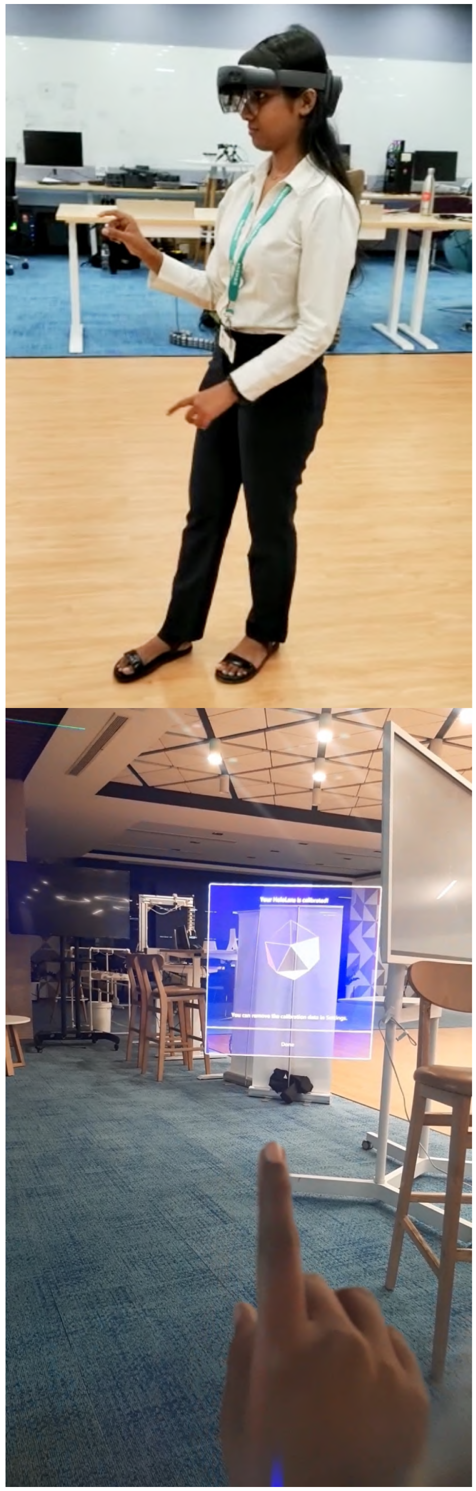


Fig 5.3: Microsoft HoloLens Device Exploration

CHAPTER 6:
DESIGN FRAMEWORKS FOR FIRST TIME USER EXPERIENCE OF INDUSTRIAL METAVERSE

6.1 Learning by Doing

Learning by doing is the hands-on approach which states that people must interact with their environment in order to adapt and learn. It is also called as Kinaesthetic Learning. A kinesthetics or tactile learning is a learning that involves physical activity. It requires that you manipulate or touch material to learn. Kinaesthetic-tactile techniques are used in combination with visual and/ or auditory techniques, producing multi-sensory learning.

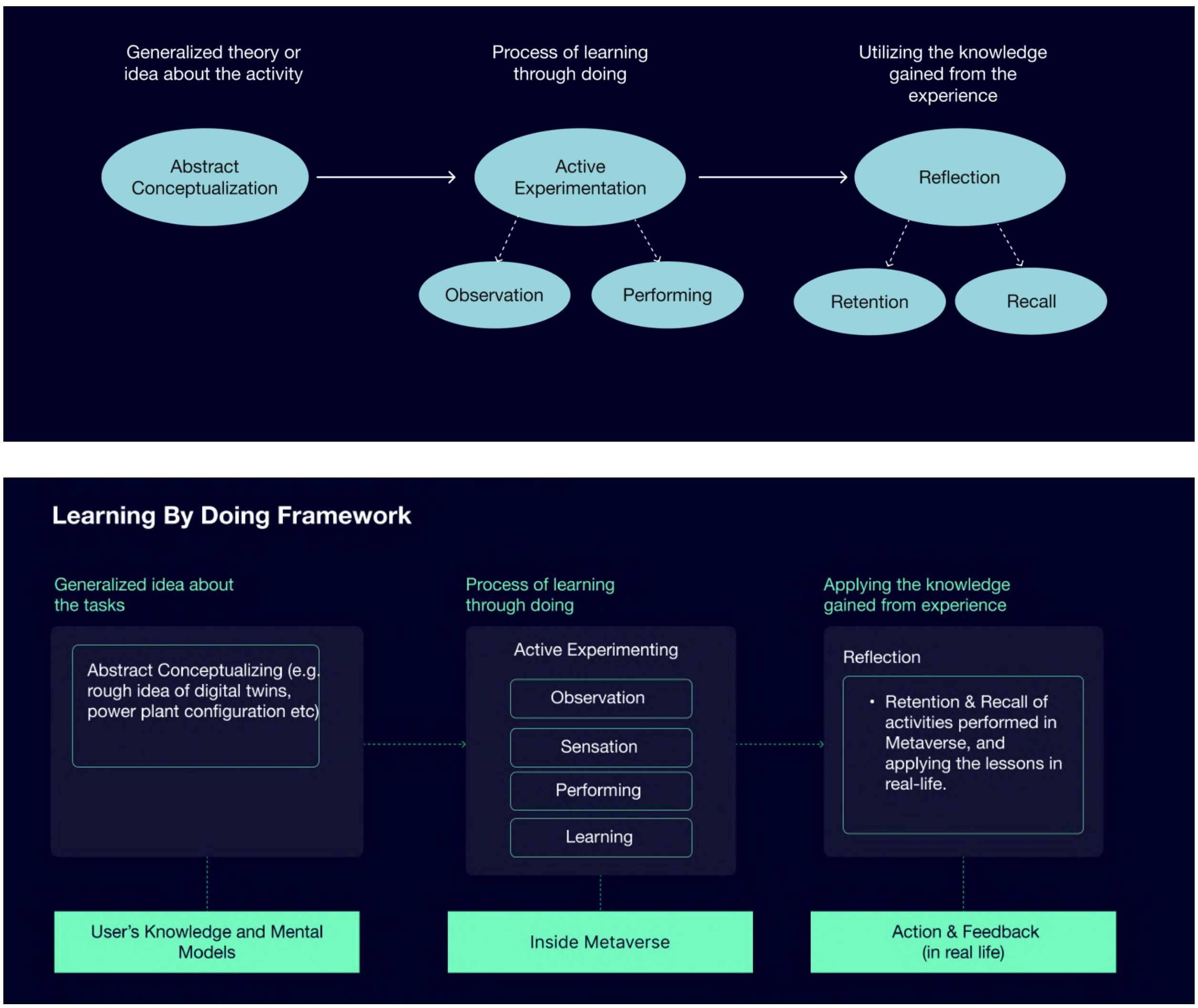


Fig 6.1: Learning by doing framework

6.2 Context Setting

The designed framework explains how Context Setting can be implemented while designing an experience. Splash screen is the first element that user sees when application is launched. After giving user sight of splash screen, onboarding process can potentially explain user about the **What** (What application has to offer to user) & **How** (how user can access those features) of application. Or in simpler terms giving user introduction of the application and instructions to use the applications. If Personalisation and Customization are part of the application, then also introduce them at onboarding stage. Can be taught to user users using simple but useful contextual cues or proper instructional walkthroughs which consists of detailed step by step process.

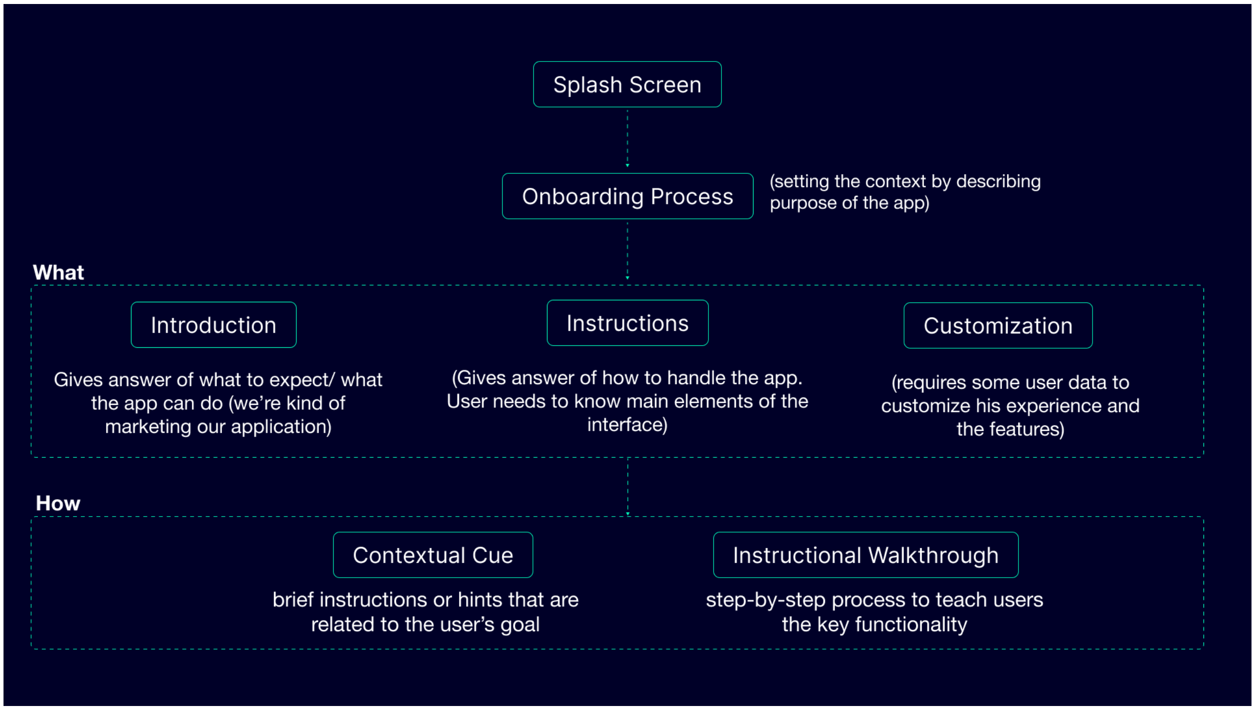


Fig 6.2: Context Setting Framework

CHAPTER 7: DESIGN IDEATION

7.1 Ideation sketches

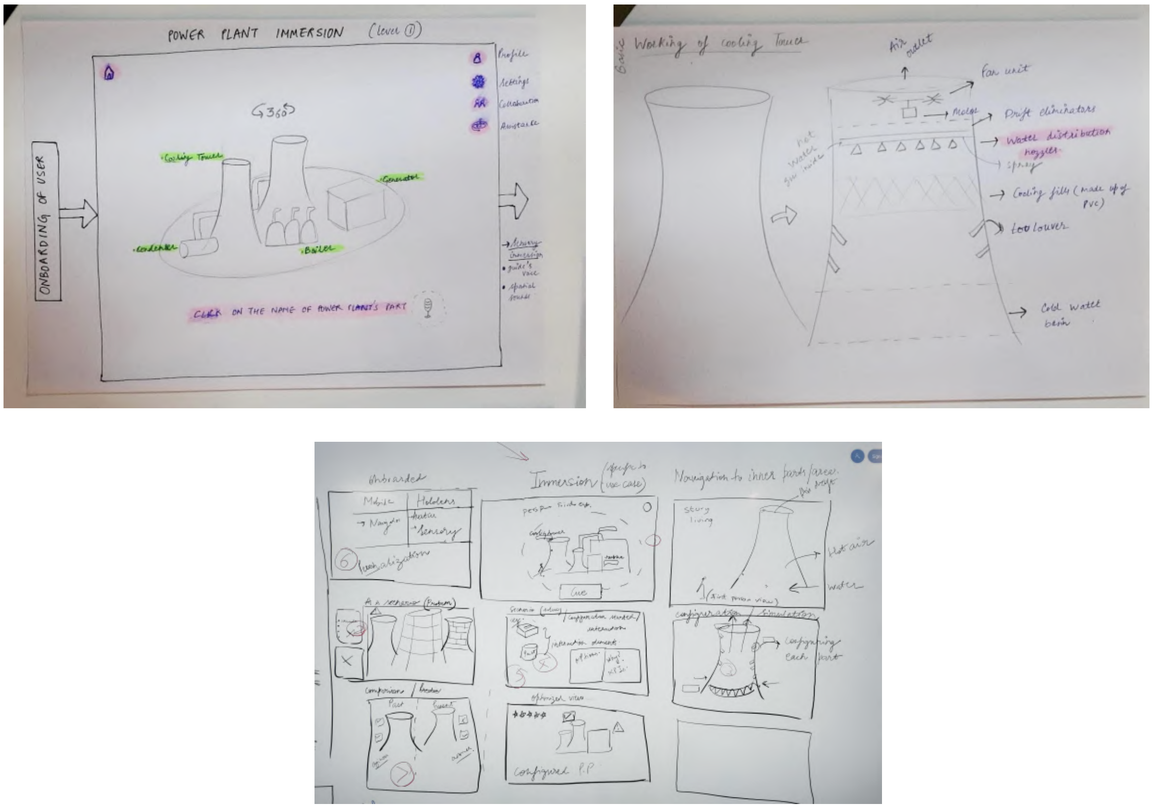


Fig 7.1: ideation Sketching

7.2 Designing Experience

1. Guiding hands cues
User watches hands guiding him. Action happening triggers user to follow same while enhancing his learningFig 7.1: Hand Gestures

2. Guiding statements
Short & precise User reads what to do next. hands and statements complementing each other

3. Tool tips
Make user aware about the name or function of icon & other elements

4.Ergonomics guidance
For ease in taking actions, less physical fatigue

5. Visual guide
User stays informed about his action (successful or failed) and motivates him to continue

6. Configuration status
User stays aware about configuration status
(motivates him to complete tasks)

7. Relative Scale
User can see the relative scale of model (and change)

8. Spatial audio
Provides a realistic 3D immersive sound

9. Hand-gesture based interaction
Provides flexibility to interact with objects from near & far both

11. Auditory guidance
To reduce user's efforts of reading, he can follow instructions by listening

12. Speech input
Saves user from manually typing and performing hand gesture. User can speak to open menu, click buttons or search item.

7.3 Designing Environment

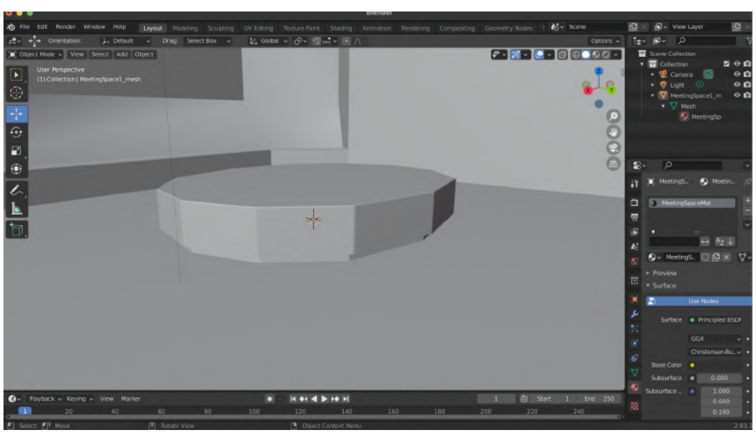


Fig 7.2: Powerplant component compilation in Blender

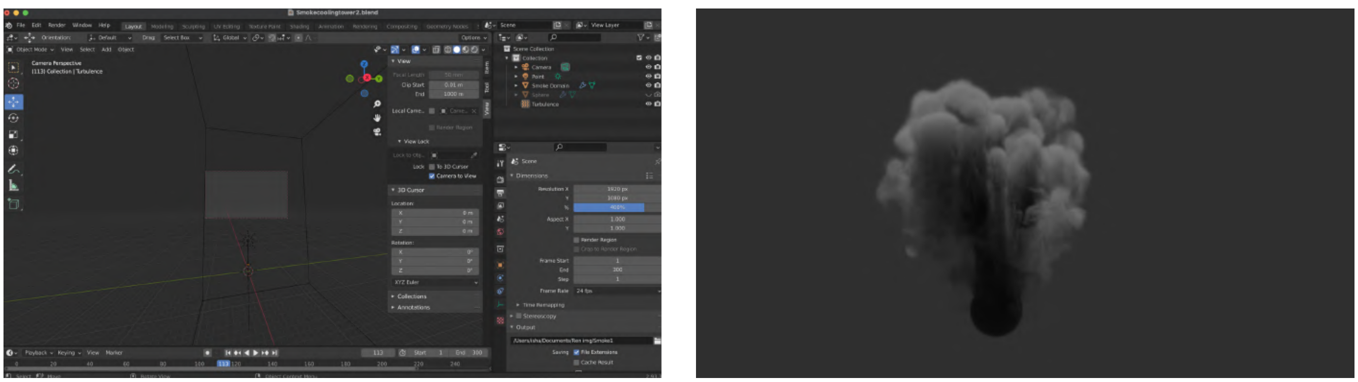
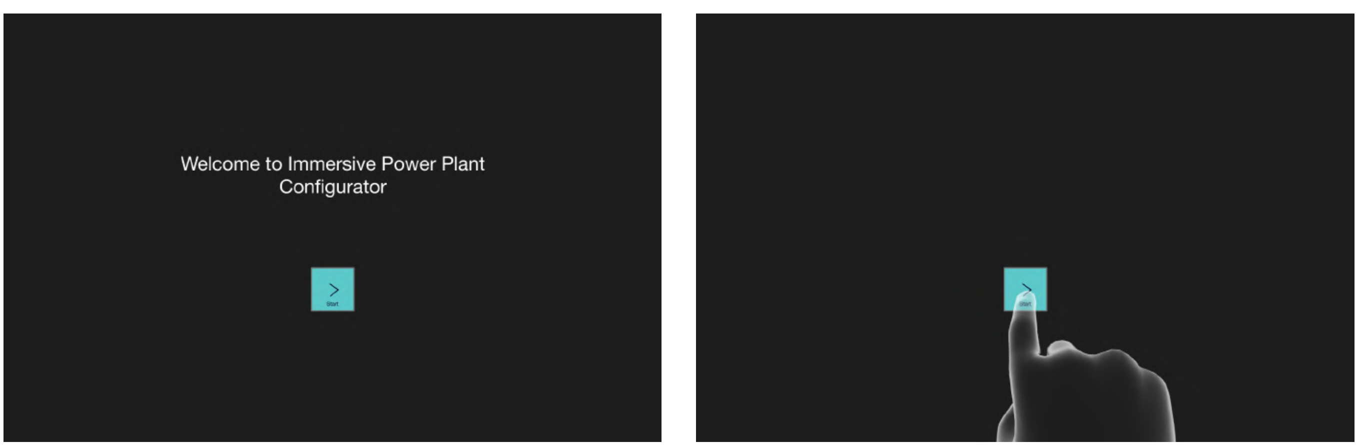


Fig 7.3: Animation in Unity & Blender

7.4 Wireframing



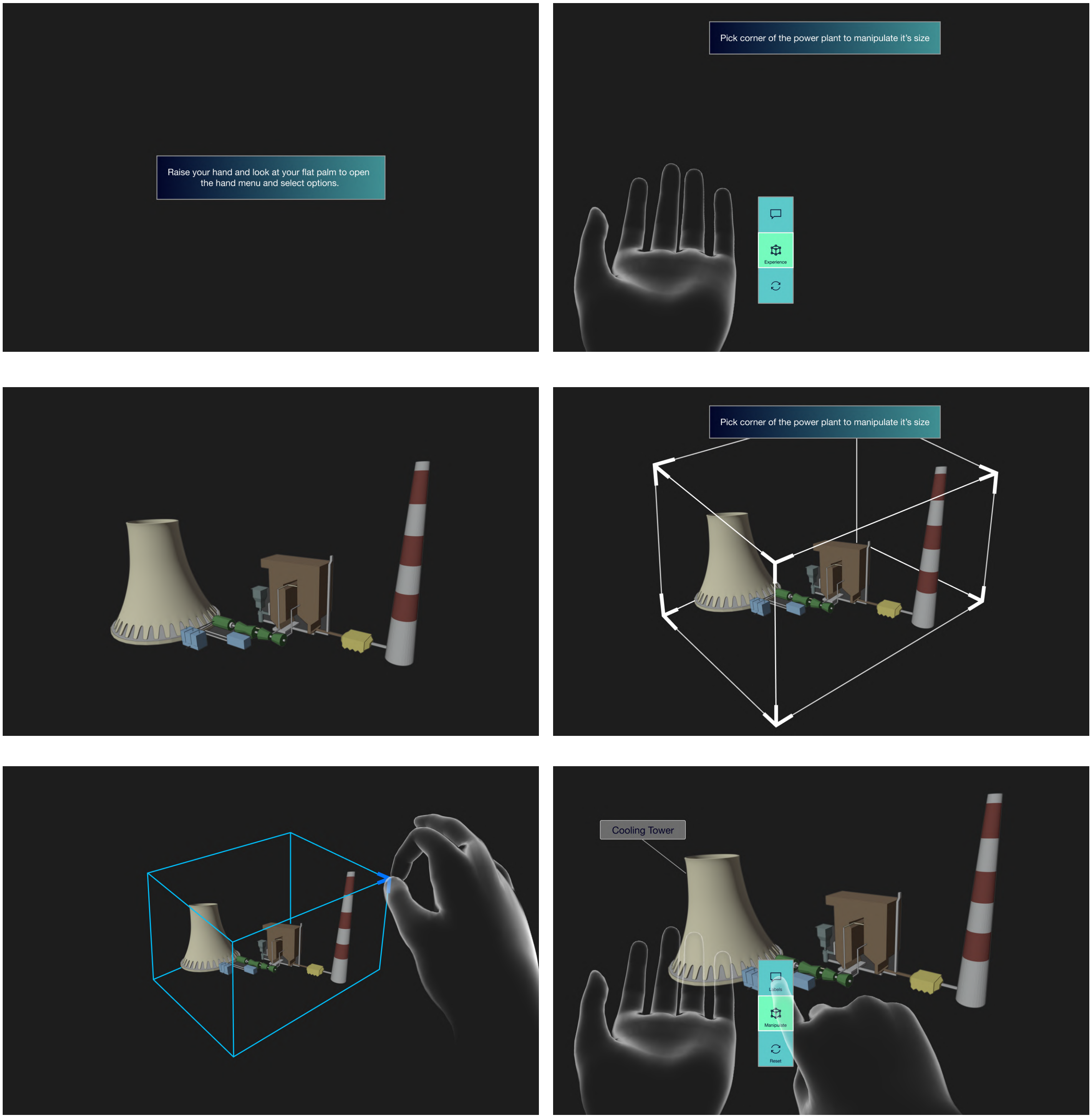


Fig 7.4: Scenes Wireframing

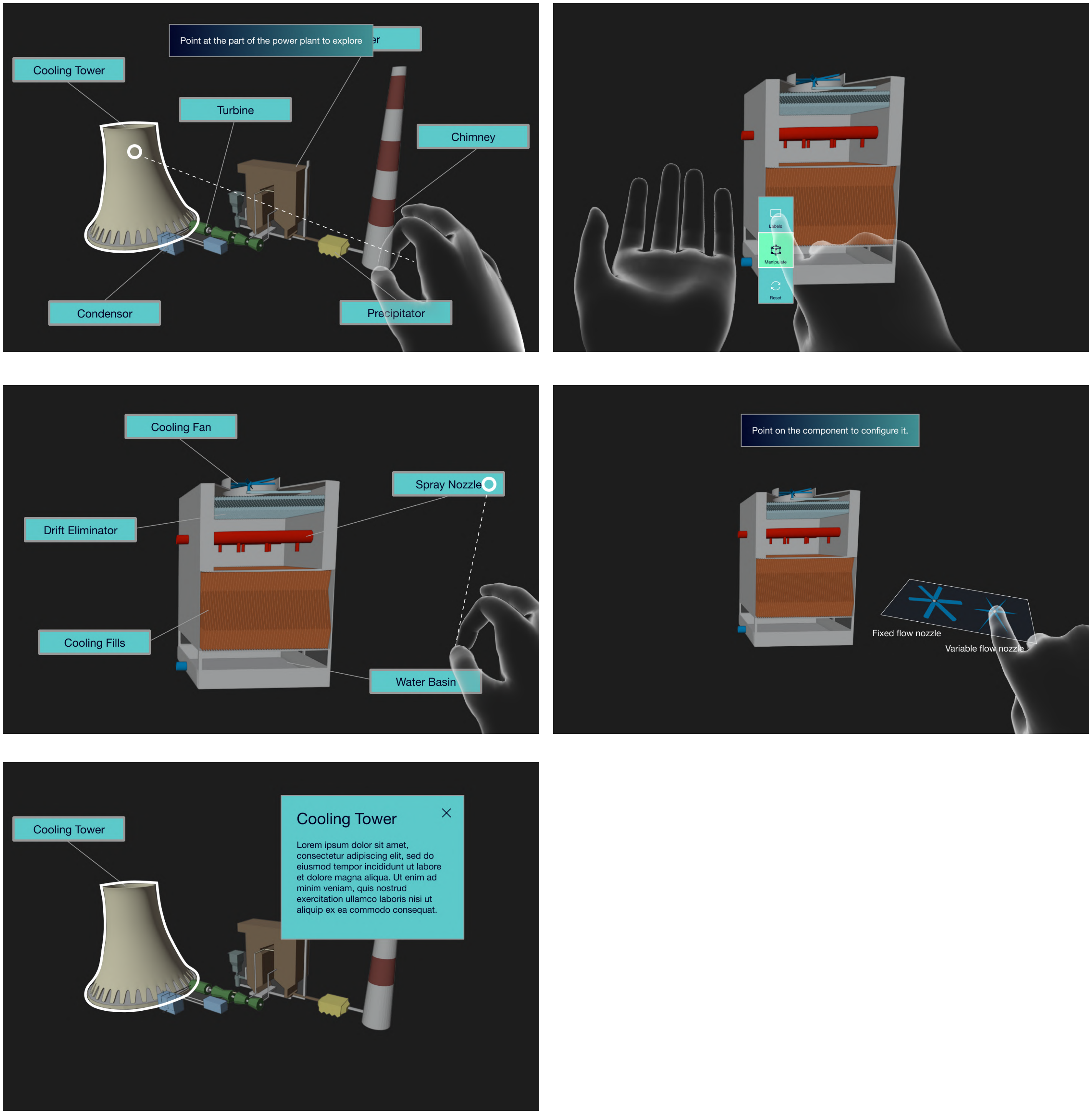
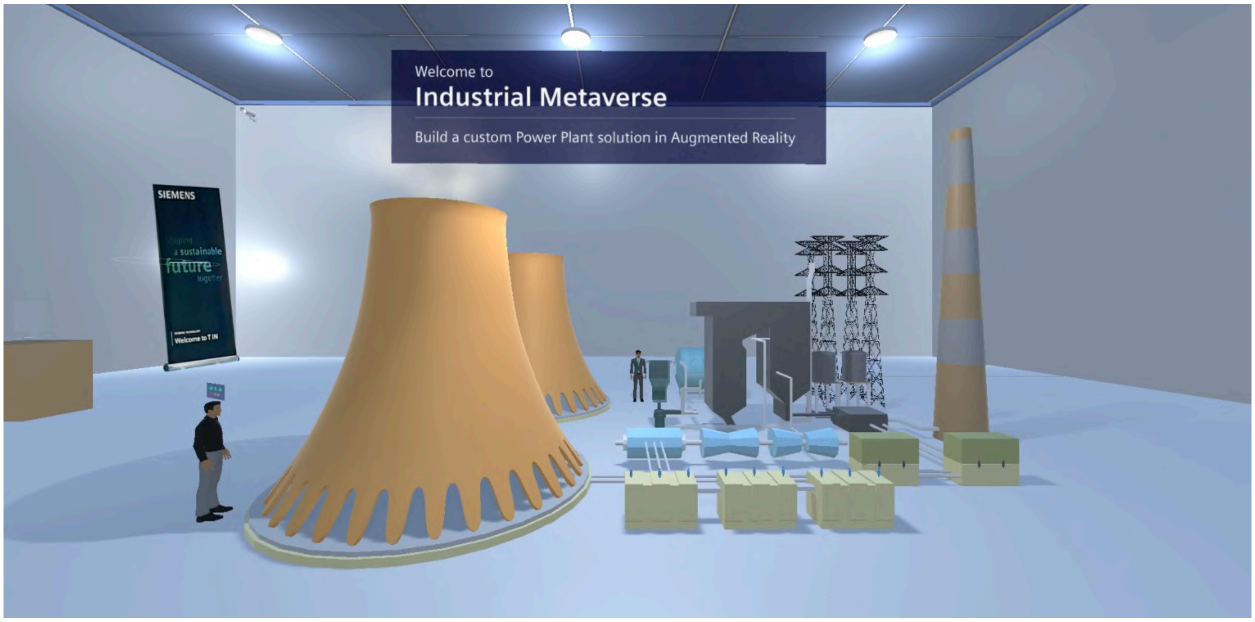


Fig 7.5: Scenes Wireframing

CHAPTER 8: FINAL DESIGN & PROTOTYPING

Following scenes of designed experience are created in Unity Software:

Onboarding Experience: As user enters in Metaverse, context Setting and situational Awareness is provided which helps to understand intent of the system i.e, what environment and experience user can expect in his journey.



Splash screens are presented to users to make them understand the functionalities i.e, what all they can do inside Industrial metaverse.

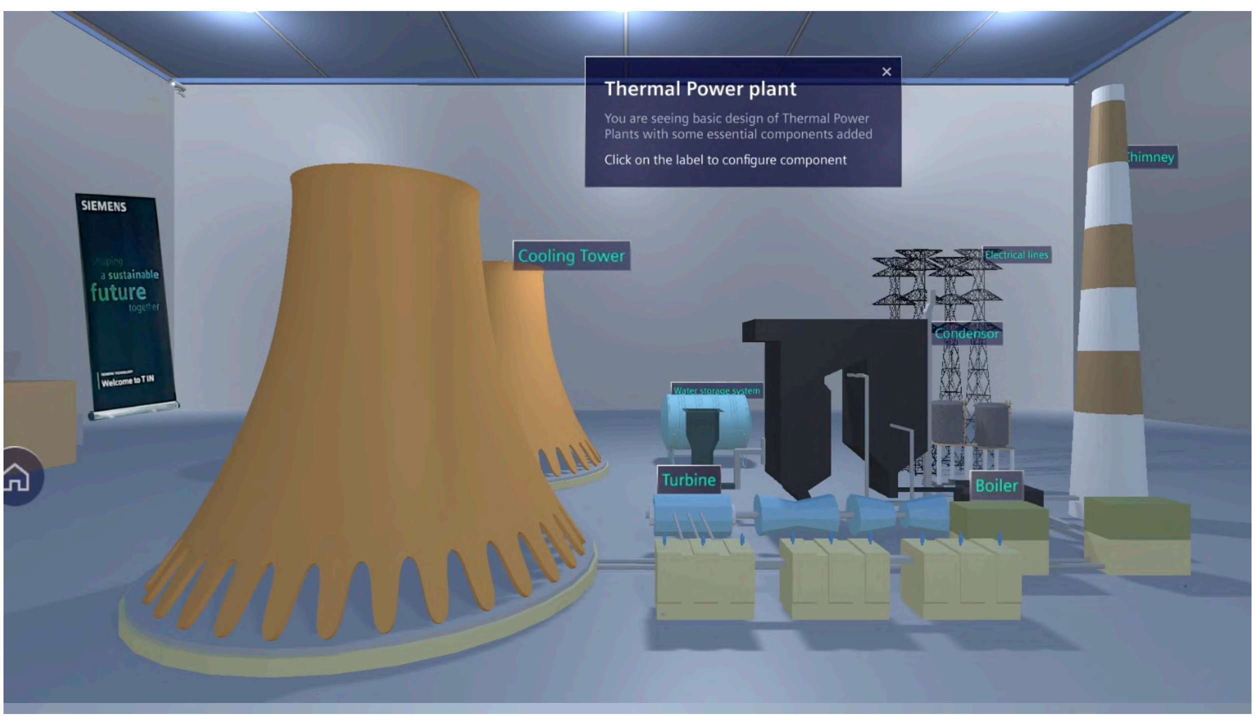
Literal Hands-on-tutorial are presented to users, which they can see and follow. This aims to enhance their learning-by-doing.

Unawareness about the use of buttons causes barrier in initiating the use of application, hence it is taught how to use menu buttons.

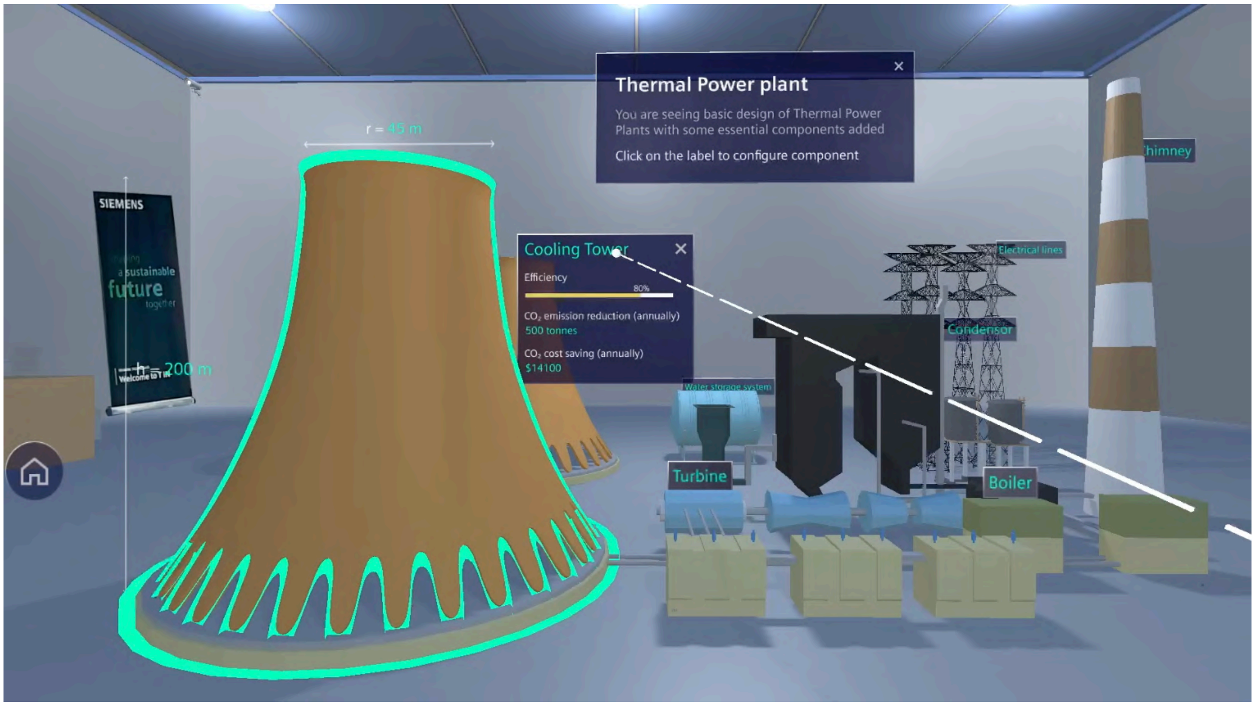
Then, demonstration of how to use global navigation menu is shown to user

Ergonomical guidance is given to users so they don't face physical fatigue.

In this scenario, users encounter **Digital Twin of Power Plant**. Information Augmented happens on outer view Power plant which Users can interact with.

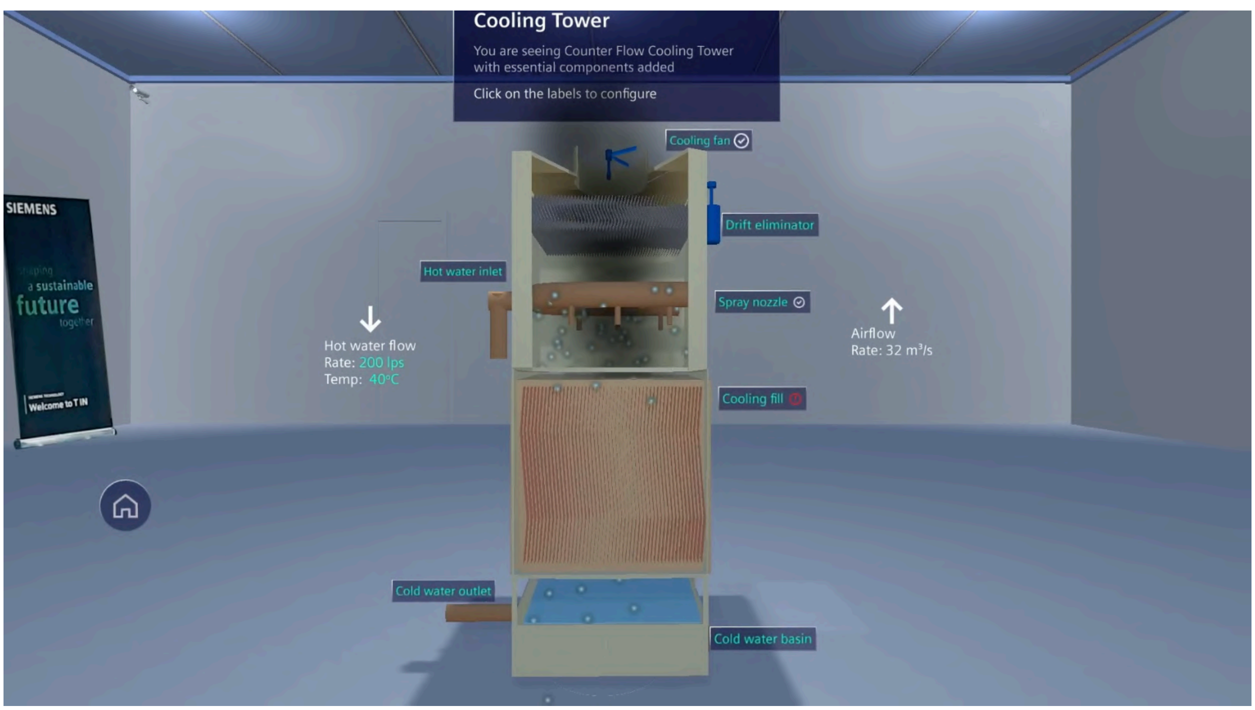


3D Information is augmented on Digital twin of power plant to enhance user's understanding about various aspects of different components of power plant.

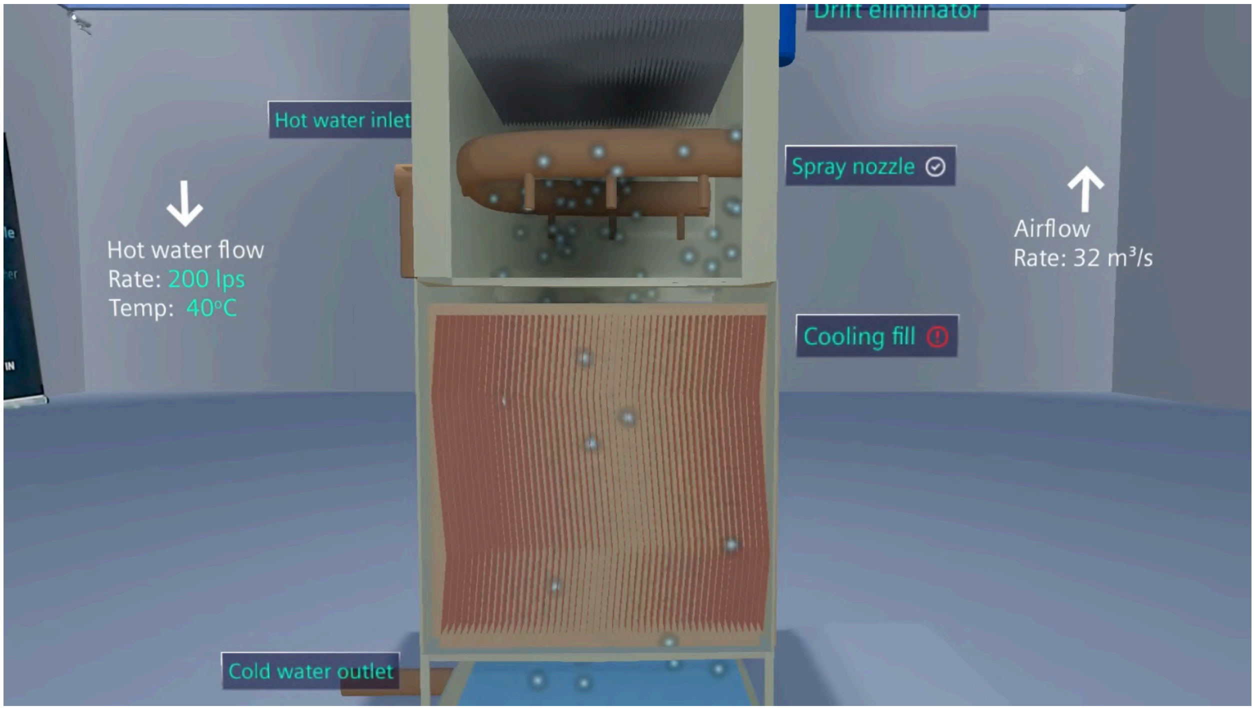


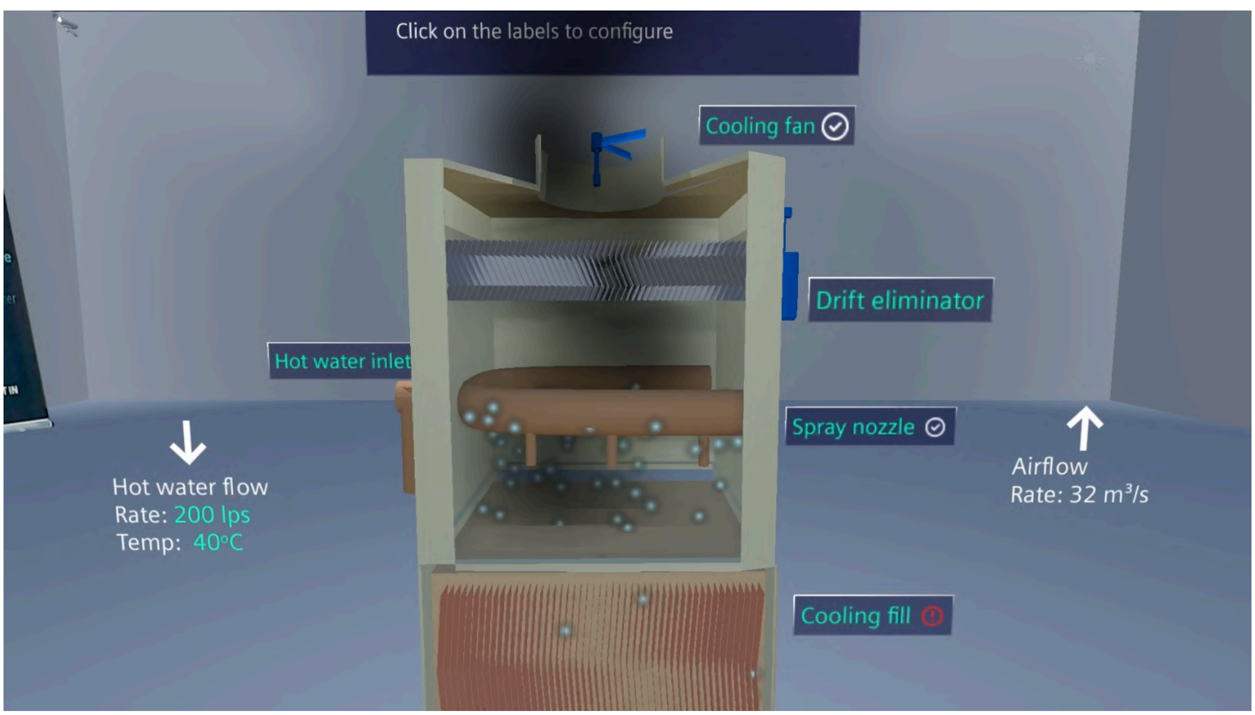
User has flexibility of selecting the specific component to explore, investigate and configure it further.

Demonstration of working of the component of power plant is given

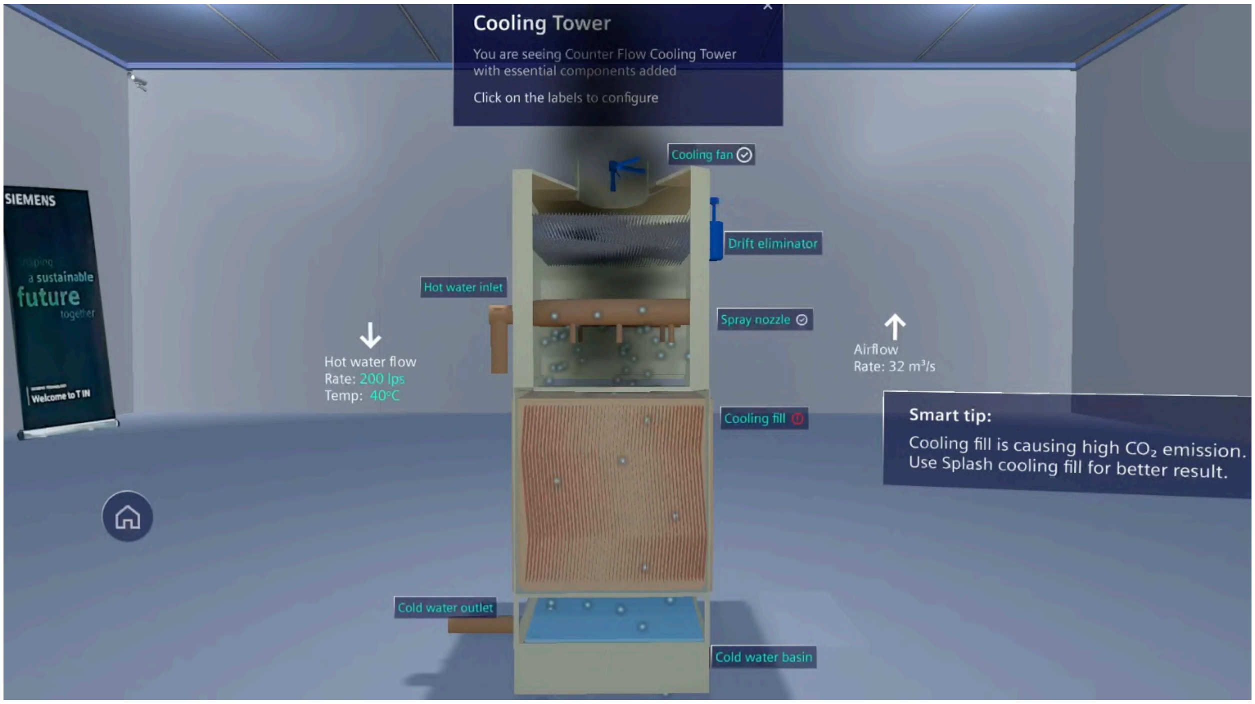


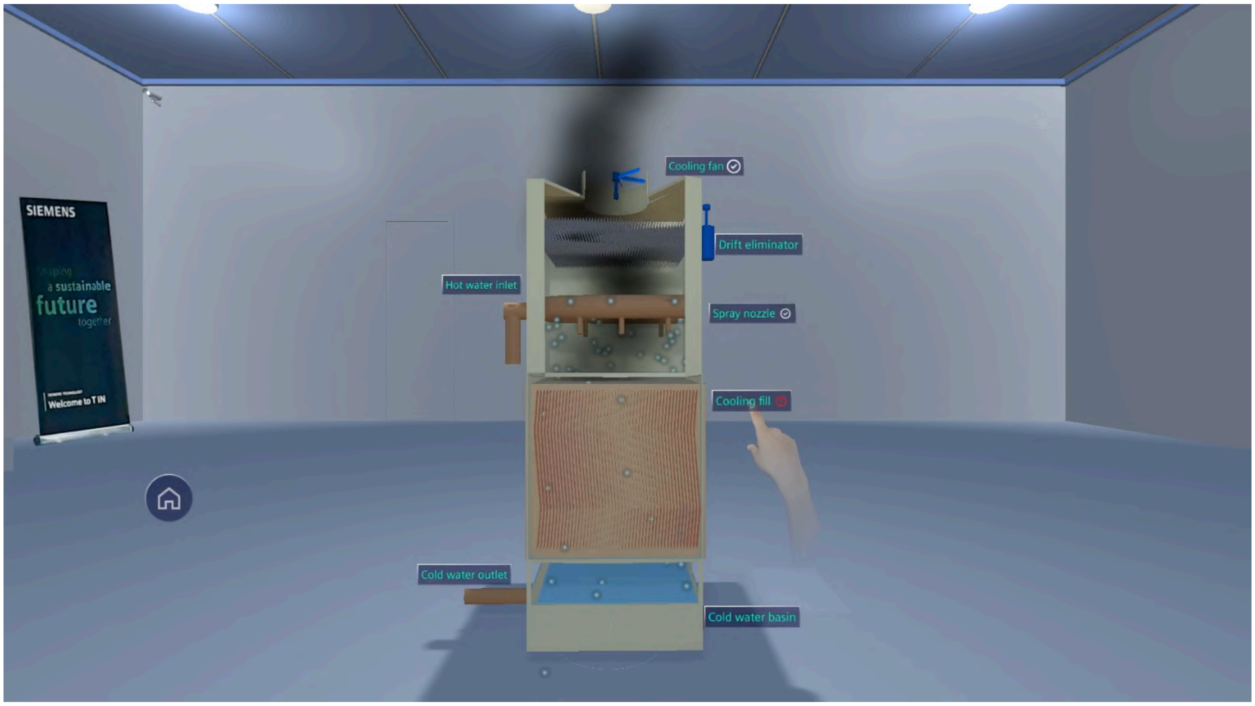
User can understand working of each part & investigate in details (eg: water falling shows working of spray nozzle and speed of water flow)

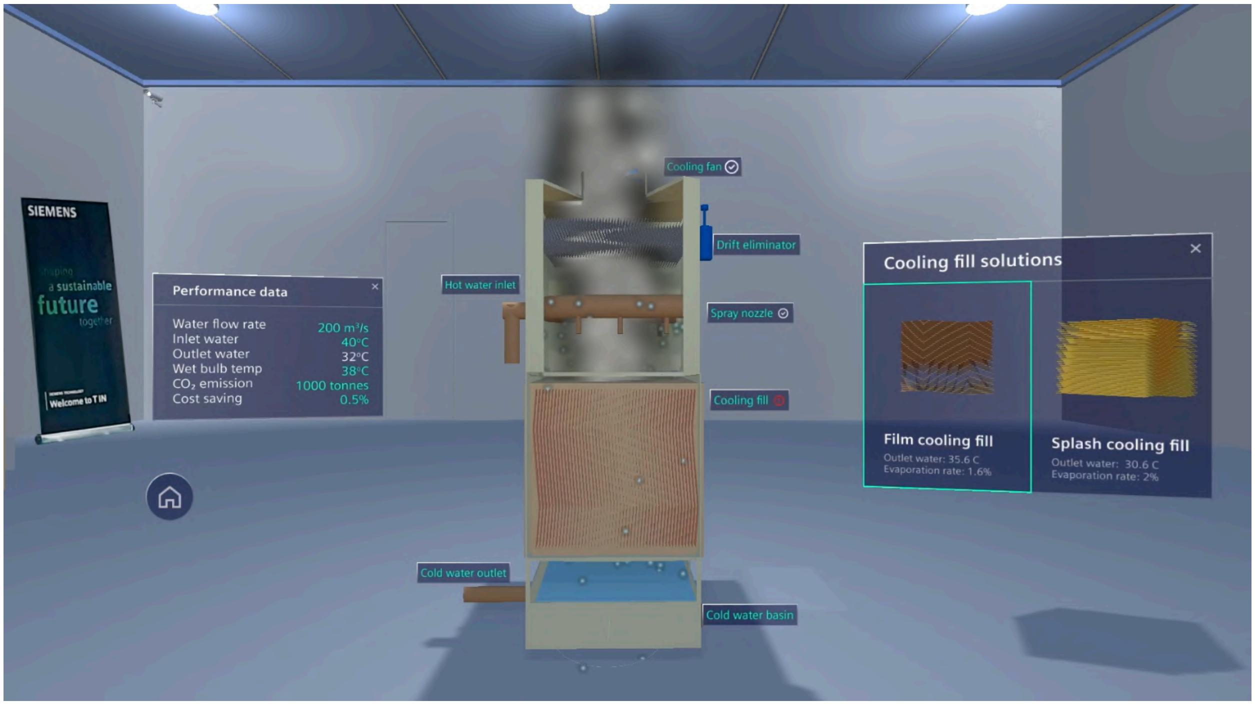




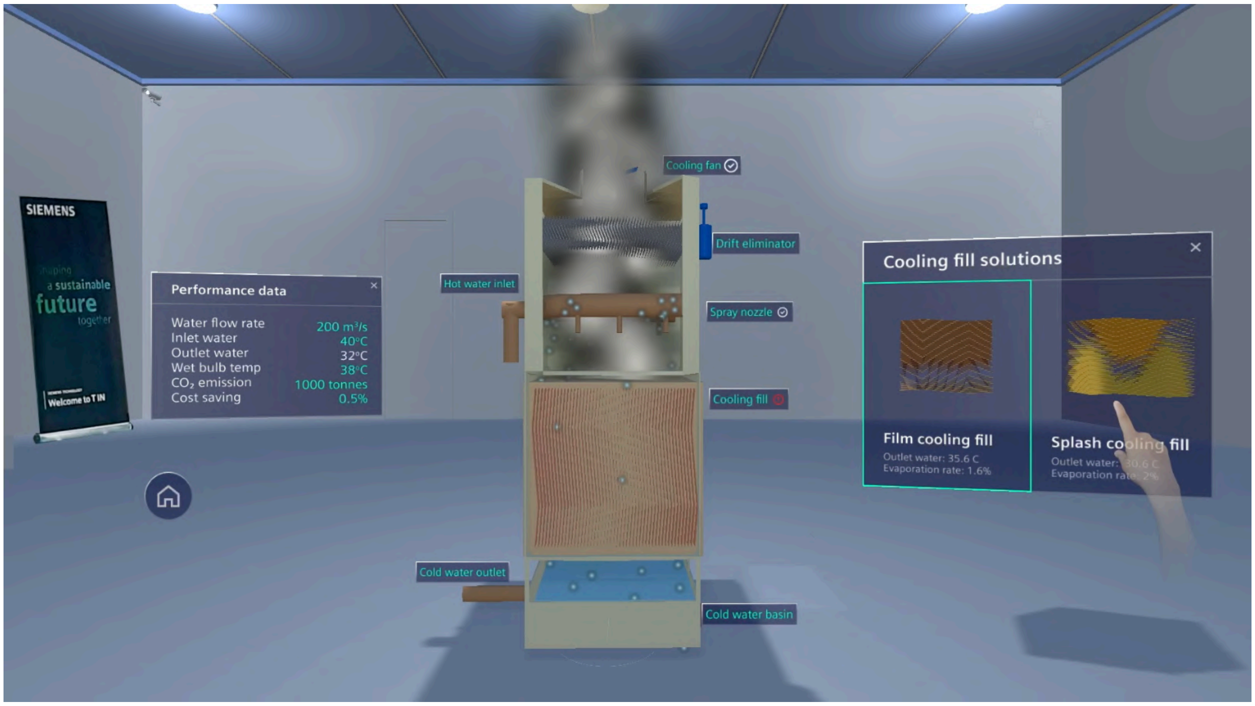
Demonstration of user interacting with the sub-component to configure it. Tips are given to user guiding him to make better choice.



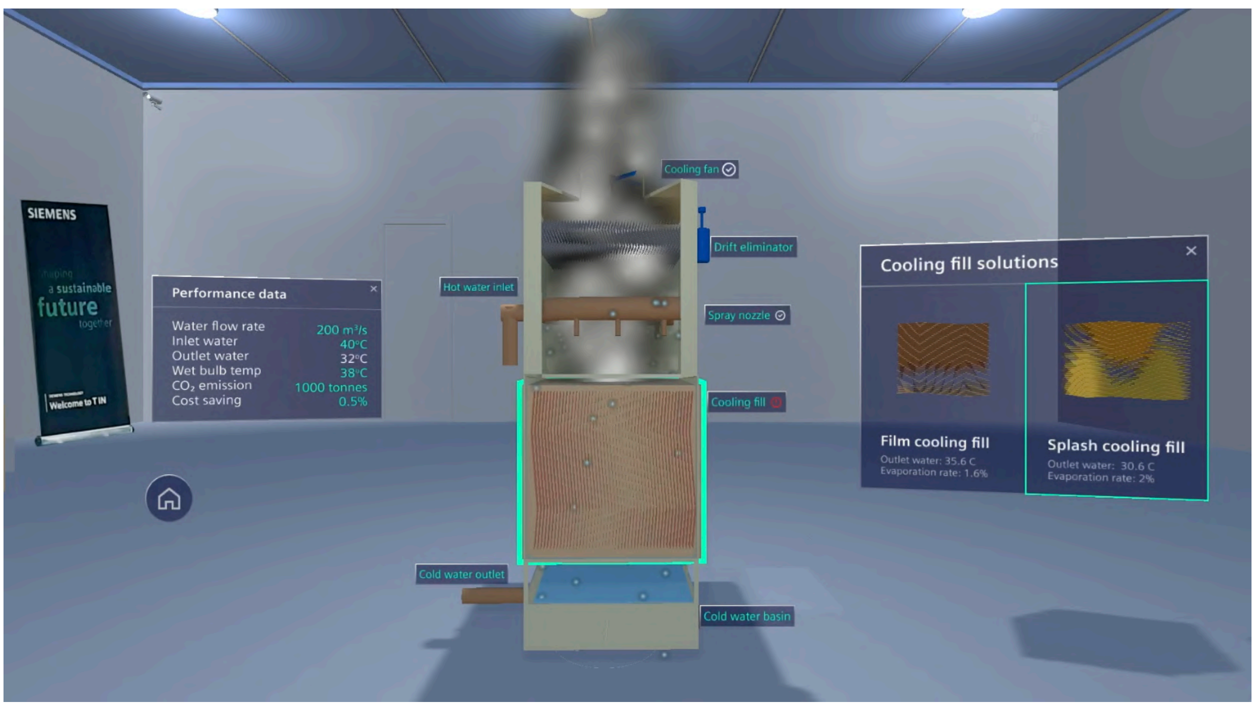




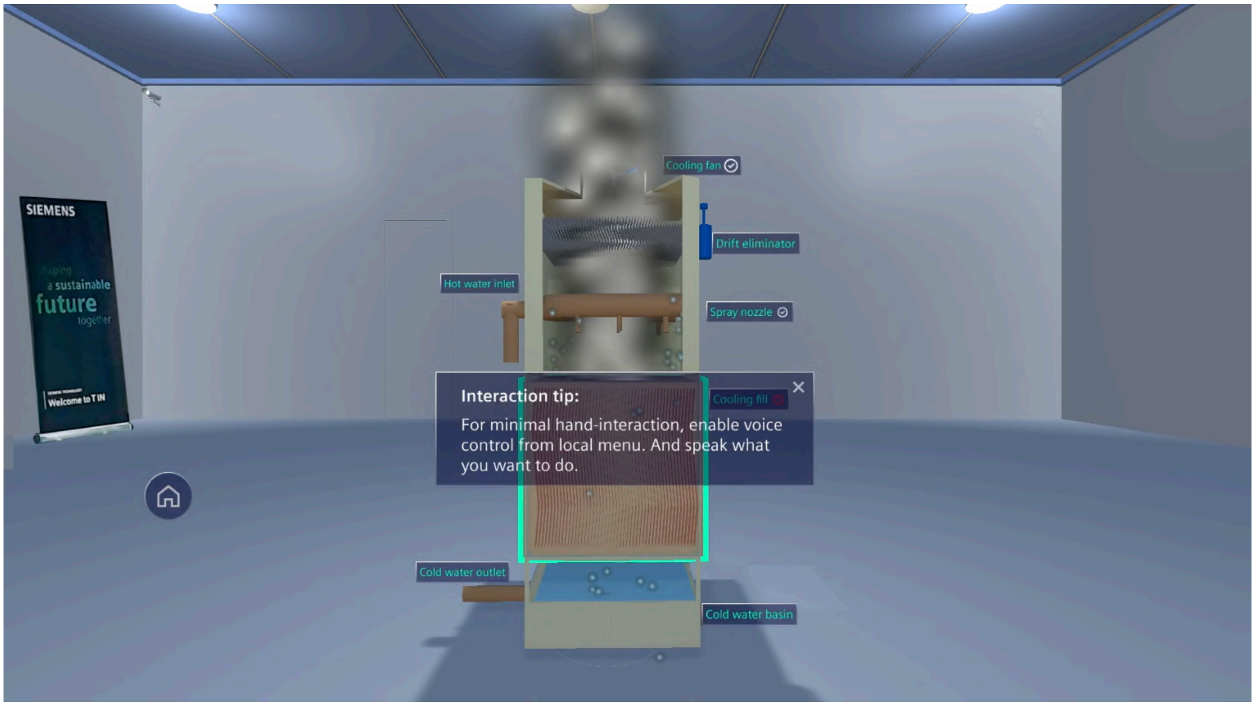
Change in color of smoke complements the performance of the component.

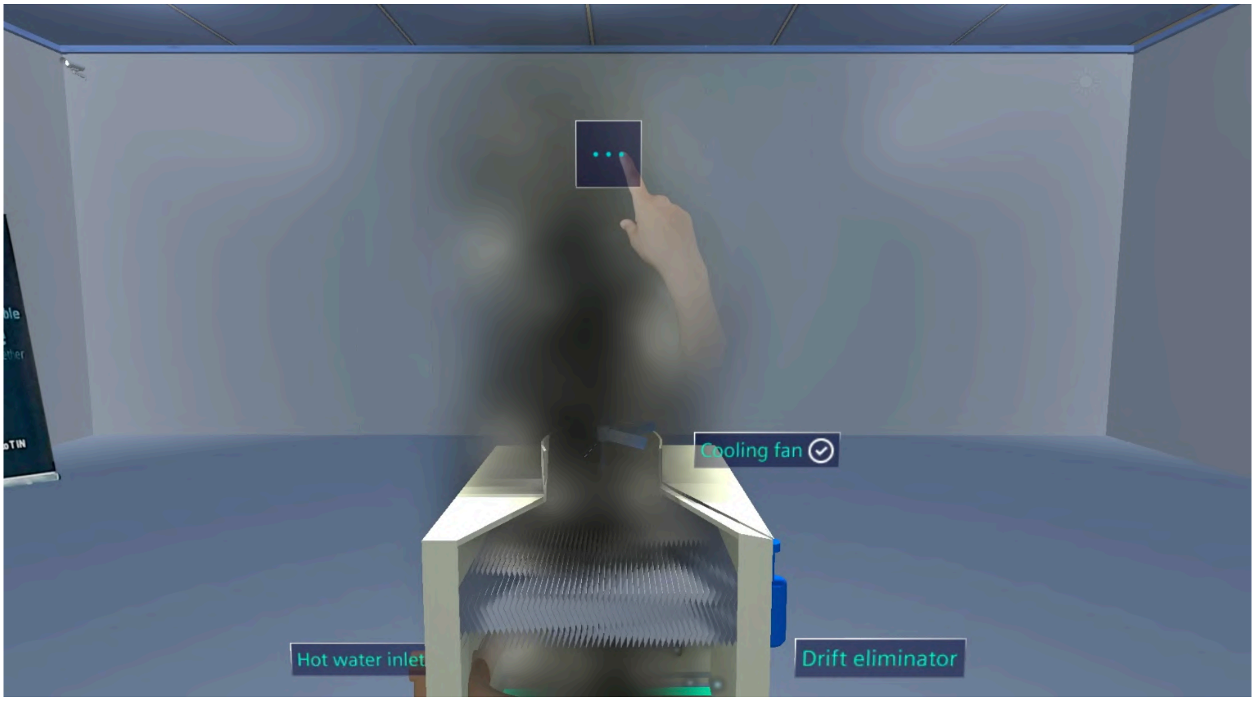


Demonstration of user selecting suitable option/ variable to configure component of power plant. He can also see the performance result of each of the option.

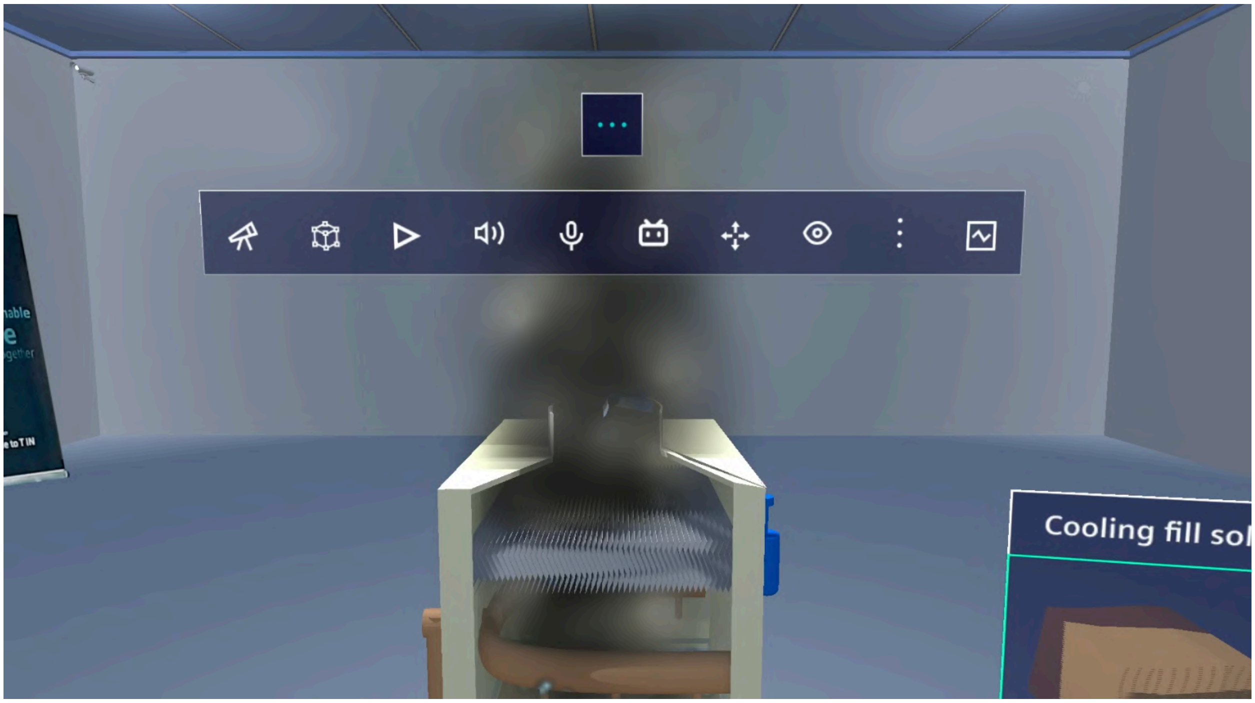


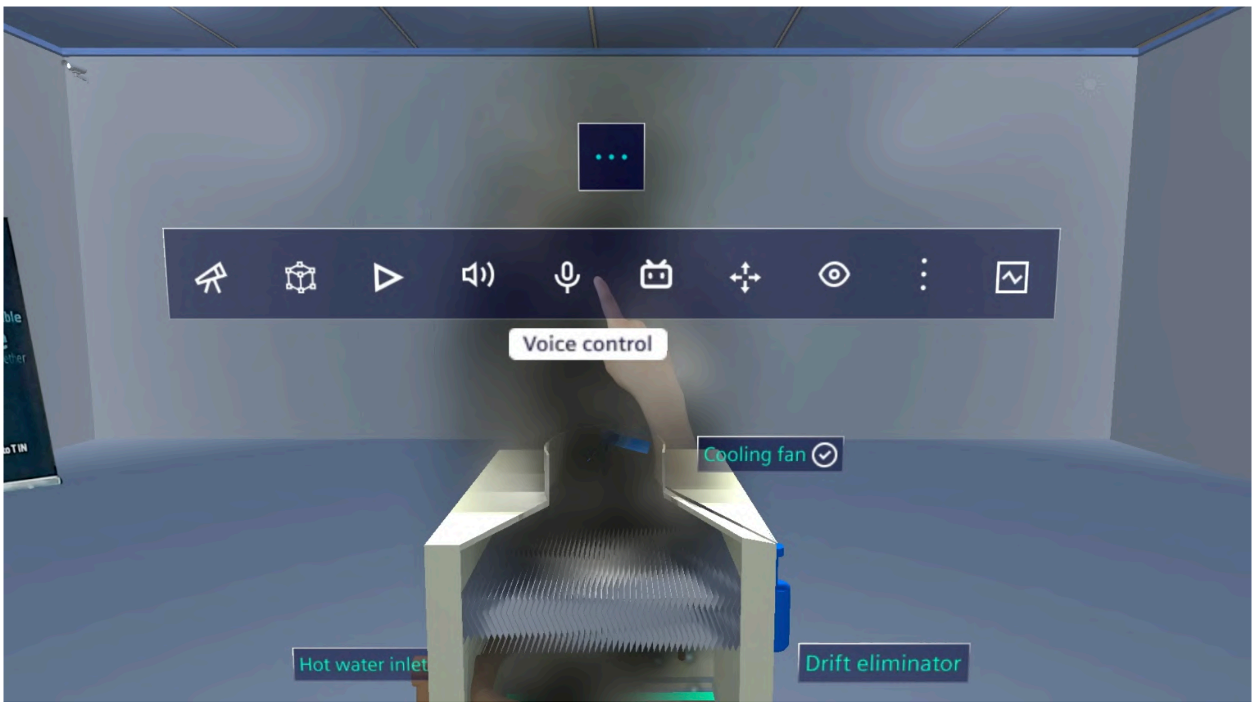
User is guided about how he can reduce hand-interaction by enabling other features such as voice control.





Demonstration of local navigation menu and various features given in the menu to enhance user's experience and making the configuration in Metaverse easier.





8.2 User Experience Matrix (HEART METRICS)

	GOALS	SIGNALS	METRICES
HAPPINESS	Users should enjoy from start (from entering the Metaverse to ending the configuration)	User's verbal statement, expressions and actions.	• User survey • User interview • User's expression analysis
ENGAGEMENT	User shouldn't feel bored inside the environment. He should be engaged and keep interacting with the virtual environment, assets and information.	Users involvement with the immersive environment	• Time spent inside environment • Time spent with intractable objects • No. Of virtual elements user interacted with • No. of clicks on interaction buttons
ADOPTION	User should be willing to visit and use the immersive experience	New users reaching to the platform & signing up	• No. of new registration • Extent of personalisation done
RETENTION	User should visit again/ or complete the task before leaving the platform	Users returning to the platform after their first visit/ login	• No. of login (gives data of people visiting again) - active users
TASK SUCCESS	User should be successful in configuring all the components of power plant	Users reaching the end stage of experience	• No. of successful profile creations • No. of successfully configured power plants • No. of plant approvals given

Table 8.1: User Experience Matrix (HEART METRICS)

CONCLUSION & FUTURE POSSIBILITY

The project titled **'Immersive Power Plant Configuration: Designing for First Time User Experience'** is explored and implemented a novel approach to configuring components of Power Plant in an Augmented Reality environment using Microsoft HoloLens. Through extensive research and design iterations, various experiential aspects of the industrial metaverse have been examined, ranging from ergonomics to visual aesthetics.

By addressing the challenges of first time user experiences, the project has demonstrated the significance of intrinsic motivation factors in driving long-term commitment and satisfaction. The development of a tailored design framework and the creation of a compelling storyline have further enriched the immersive nature of the immersive powerplant configuration in metaverse virtual exhibition, enhancing user adoption & engagement.

Future possibilities include enhancing the user's repetitive experience, incorporating rest of the user experience stacks & patterns which have been researched upon but were not dominant for first time user experience. With ongoing collaboration and advancements, the industrial metaverse holds promising opportunities for transforming product configurations and creating immersive and interactive experiences.

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