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*Human Centered Design*

**MCP697z | Capstone Project**

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**Project Report: Threads Through Time**

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# Threads Through Time

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**Presentation Title:** Threads Through Time

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## **Abstract:**

**Threads Through Time** is a mobile application designed to allow users to explore India's vast clothing heritage in an interactive and immersive way. Inspired by the decline in emotional engagement with cultural attire among younger audiences, the platform enables users to try on AI-generated traditional outfits from various historical periods using augmented reality (AR) and tangible interaction.

The idea originated from a desire to make fashion history accessible, experiential, and educational. The project was validated through extensive research, including global case studies, surveys, and user interviews. A working prototype was developed using tools like **Stable Diffusion**, **ControlNet**, **TouchDesigner**, and **physical AR markers** representing different eras.

Unlike conventional museum setups or textbook visuals, Threads Through Time integrates **cultural storytelling, narrative depth, and real-time engagement**. The goal is not only to showcase garments but also to contextualize them, enabling users to **embody history rather than just observe it**. Through this platform, we aim to redefine how cultural heritage is experienced in the modern digital age.

## Introduction:

In the early stages of our research, we identified a growing disconnect between India's vibrant traditional attire and the way it is currently accessed and experienced by modern audiences. India's clothing heritage spans thousands of years—from the Paleolithic period's tribal wear to the intricate Mughal drapes and the handwoven simplicity of Khadi during the independence movement. These garments are not just clothing; they represent **identity, belief systems, and cultural evolution**.

Yet, despite their importance, this living heritage is often presented through **static means**: framed photographs, mannequins, or dense academic text. These methods fail to create emotional or sensory engagement, especially for younger generations who are more responsive to **interactive digital experiences**. In the post-COVID era, where screen-based learning has become more dominant, there's a visible shift toward **participatory and immersive content**.

On one such day, while exploring cultural material for academic reference, the idea of enabling users to "wear history" through technology sparked the foundation of our project—**Threads Through Time**. The goal was clear: bridge the sensory and emotional gap between India's heritage clothing and today's users using **augmented reality (AR), generative AI, and tangible interfaces**.

Through physical, marker-based cards that represent different time periods, users can scan and try on traditional outfits virtually. These AI-generated visuals adapt to real-time user posture and appearance.

## **Problem Definition:**

**Problem Definition:** During our initial research, it became clear that traditional Indian clothing is underrepresented in interactive learning environments. While cultural garments are celebrated during festivals or special occasions, consistent engagement with their history, symbolism, and regional variations is often missing. Our goal was to understand why this disconnection exists and what barriers prevent users from engaging more deeply with fashion heritage.

We identified several core problems:

- **Lack of engaging mediums:** Most information about traditional attire is either academic or static—museums, documentaries, or old family photos.
- **Limited interactivity:** There is little opportunity for users to try, experience, or relate to what people wore across different periods.
- **Cultural distance:** Young users often don't understand the meaning, function, or aesthetic reasoning behind historical garments.
- **Tech mismatch:** While today's users are digital natives, heritage experiences are rarely designed for mobile, AR, or AI platforms.
- **Fragmented knowledge:** There is no single, intuitive platform where users can explore clothing across Indian timelines in a visually immersive way.

We validated these assumptions through a Google Form–based survey, which received **99 valid responses**. The insights were striking:

- **76.7%** had never experienced traditional fashion through AR or VR platforms.
- **55.8%** expressed interest in virtually trying on traditional garments.
- **60.5%** felt emotionally connected to Indian attire but rarely engaged with it beyond special occasions.
- **69.8%** learned about traditional clothing only through family or textbooks—showing a lack of accessible public resources.


## Requirements Gathering:

To ensure our solution addressed real needs and expectations, we conducted an extensive **requirements gathering** phase that combined user research with technical benchmarking. Our primary method was a **structured Google Form survey**, accompanied by informal interviews and empathy mapping sessions with our intended users.

The survey consisted of :

# QUESTIONNAIRE

## Analysis Tool



### Prarambh (The Beginning)

1. What is your name/email?
2. Age Group?
3. What is your Occupation?
4. Have you ever visited a museum or exhibition related to Indian textiles/clothing?
  - Yes
  - No
5. How would you rate your personal connection or interest in Indian traditional clothing?

• Strongly connected	• Not very connected
• Somewhat connected	• Not at all connected
• Neutral	

### Samriddhi (The Flourishing Era)

1. How do you usually learn or explore Indian traditional clothing? (Select all that apply)

• Instagram/Pinterest	• I don't engage with it
• YouTube or documentaries	• Other
• Family/Personal traditions	
• Museums/Heritage sites	
2. What limits your interest in exploring traditional Indian garments more deeply? (Select all that apply)

• Feels outdated or irrelevant	• Don't know where to start
• Not engaging or interactive	• Too complex/confusing
• Lack of digital platforms	• None of the above
3. Have you ever tried a virtual try-on or AR-based experience related to fashion or heritage?
  - Yes, and I enjoyed it
  - Yes, but it wasn't engaging
  - No, but I'm curious
  - No, and I'm not interested

### Navya (The Modern Twist)

1. Do you feel that India's textile heritage is being presented in a way that connects with today's youth?

- Definitely
- Somewhat
- Not really
- Not at all
- Not sure

2. Which of the following would make traditional clothing experiences more appealing to you? (Select all that apply)

- Being able to try outfits virtually (AR/smart mirror)
- Learning stories behind the outfits
- Personalizing traditional designs
- Sharing on social media
- Seeing famous figures wear them
- None of the above

3. Would you be more interested in heritage fashion if it were presented through immersive tech like AR, smart mirrors, or gamified storytelling?

- Yes, absolutely
- Maybe
- Not really
- No

### Bhavishya (The Future Forward)

1. What's one thing you wish digital platforms did better when presenting India's clothing heritage?

2. If you could design your own experience to engage with Indian traditional garments, what would it look like?

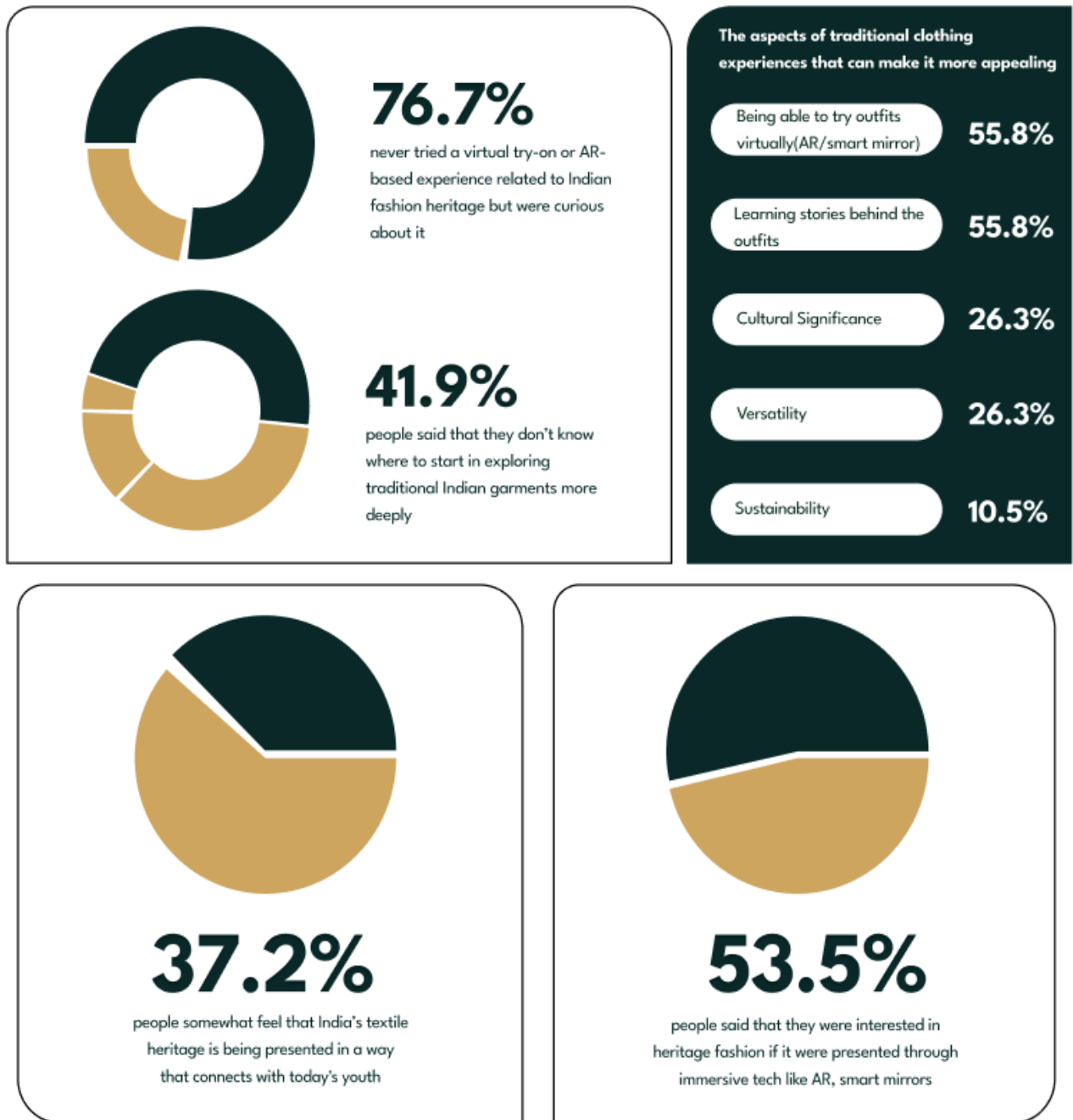
Key Findings:

**60.5%**

of the respondent felt a personal connection or interest in Indian traditional clothing

**69.8%**

people have usually learned or explored Indian traditional clothing through family traditions



#### Key User Insights from the Survey:

- **60.5%** of users indicated that they felt a *personal connection* to Indian traditional attire, showing a baseline cultural attachment.
- However, **69.8%** said they primarily learned about this attire through *family traditions*—a sign that institutional or public resources for cultural learning are lacking.

- **76.7%** of users had *never tried an AR or VR-based experience* to explore Indian heritage, yet a large majority expressed excitement and curiosity about the idea.
- **55.8%** were explicitly interested in the ability to *virtually try on traditional outfits* using an AR system.
- Another **55.8%** also expressed that they would value *cultural storytelling* integrated with the garments—suggesting a desire not just for visual display, but meaningful historical context.
- **53.5%** noted that they would be more inclined to explore traditional clothing if it were presented using **AR technologies like smart mirrors or marker-based try-ons**.
- **41.9%** acknowledged that while they were interested in cultural fashion, they didn't know how or where to begin exploring it in a modern format.

Based on this research, we focused our design on the following:

- A **marker-based AR interface** where users scan physical cards to view outfits from different historical eras
- AI-generated garments that **align with user posture and identity** in real time using **Stable Diffusion, LoRA, and ControlNet**



## Ideation:

**Ideation Abstract:** The initial concept for Threads Through Time emerged from the need to bridge the gap between India's rich, symbolic clothing heritage and the digital expectations of today's users. The idea was inspired during a discussion around how young people relate more to interactive content (like AR filters or virtual try-ons) than to static displays in museums or textbooks.

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This led us to explore ways of combining **tangible interaction**, **artificial intelligence (AI)**, and **augmented reality (AR)** to create an immersive platform. The key idea was to use **physical markers (cards)** representing different historical eras. When scanned, these would trigger **AR garment overlays** generated using AI tools like Stable Diffusion and ControlNet. Users could then try on garments in real-time using their device cameras, seeing themselves in historically accurate attire while learning about its origins and cultural meaning.

## Prototyping:

The prototyping journey began with defining the core experience: allowing users to scan a physical marker card and see themselves visualized in traditional Indian garments from different historical eras, rendered using generative AI.

In early experiments, we tested existing virtual try-on (VTON) systems like **IDM-VTON** and **SAL-VTON**. While these tools showed promise for modern clothing types (e.g., t-shirts and jeans), they proved unsuitable for our goal of rendering **complex, draped traditional Indian garments**. Their limitations included:

- Lack of training on **non-Western attire**
- Inability to reproduce **flowing drapes, ornaments, and layered textiles**
- Output quality that was inconsistent with historical accuracy

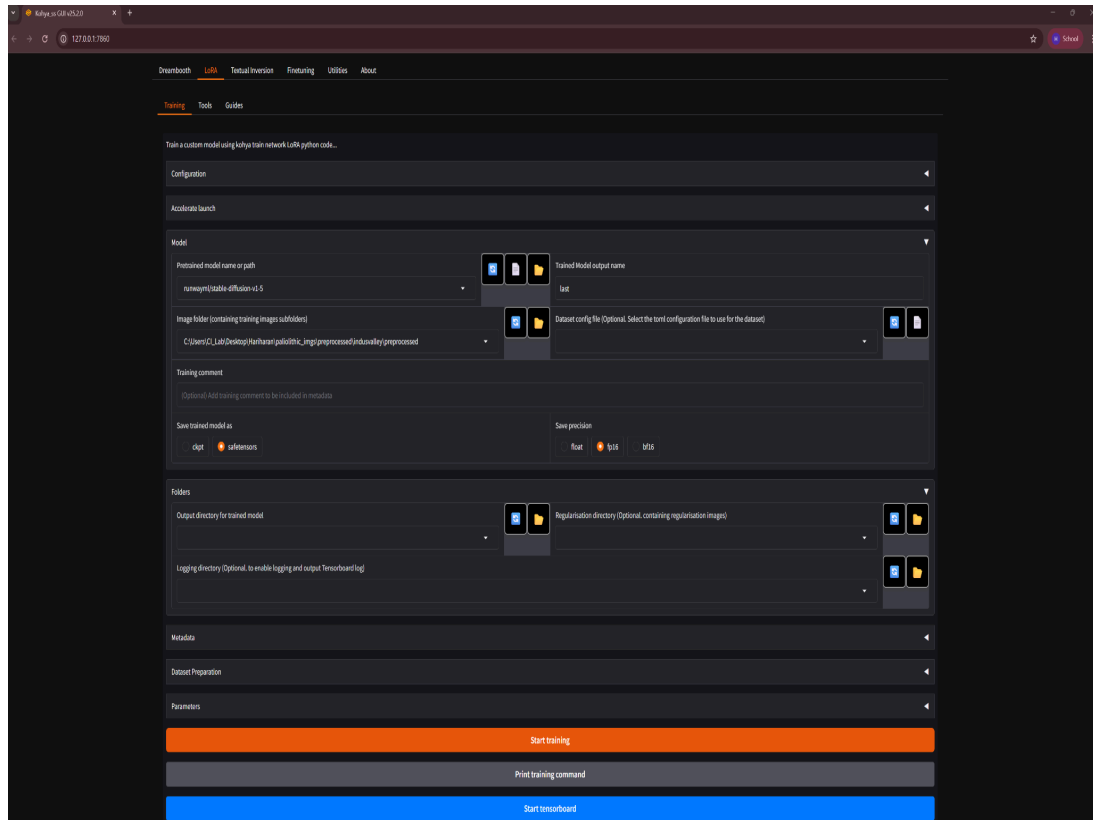
Separately, initial Stable Diffusion experiments without inpainting caused major issues in **facial identity preservation**. Generated visuals often distorted or replaced the user's face, breaking immersion and reducing emotional connection to the prototype.

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Technical Improvements for Enhanced UX:

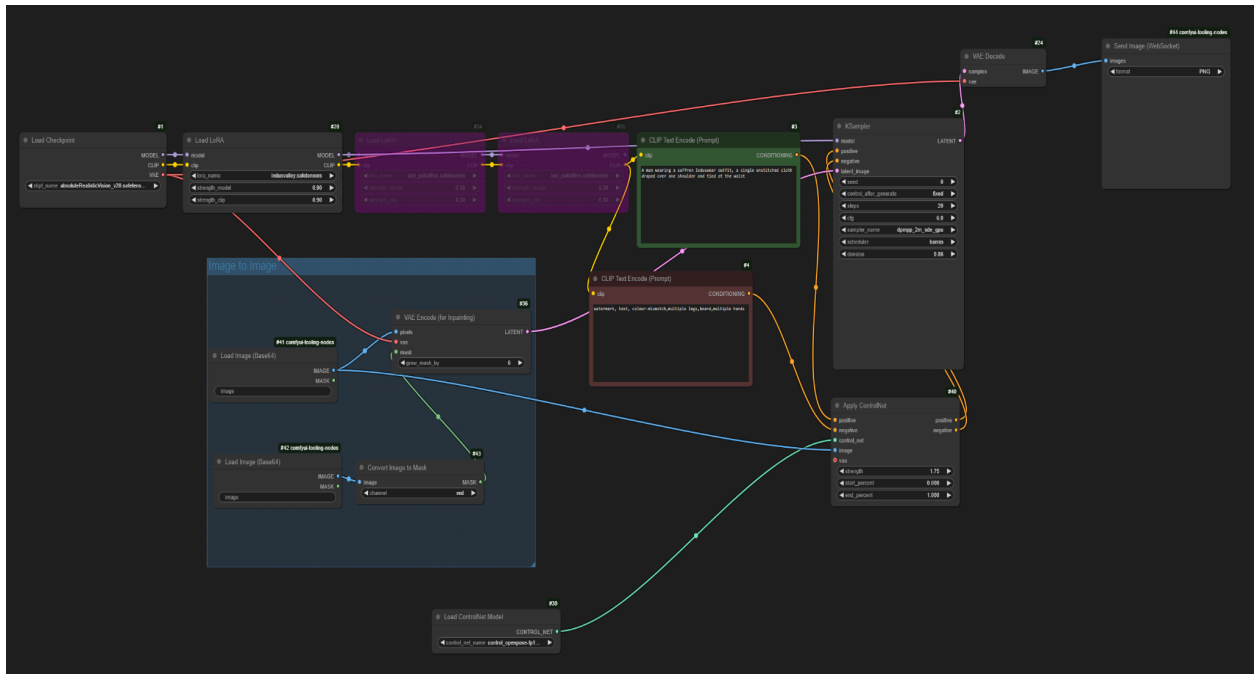
To overcome these challenges and create a more believable and responsive experience, we introduced multiple improvements to both the technical pipeline and the interaction design:

- **Custom LoRA Models:** We trained **Low-Rank Adaptation (LoRA)** modules on curated image sets for the **Paleolithic** and **Indus Valley** periods. These models enabled accurate generation of time-specific garments, draping methods, and color schemes.



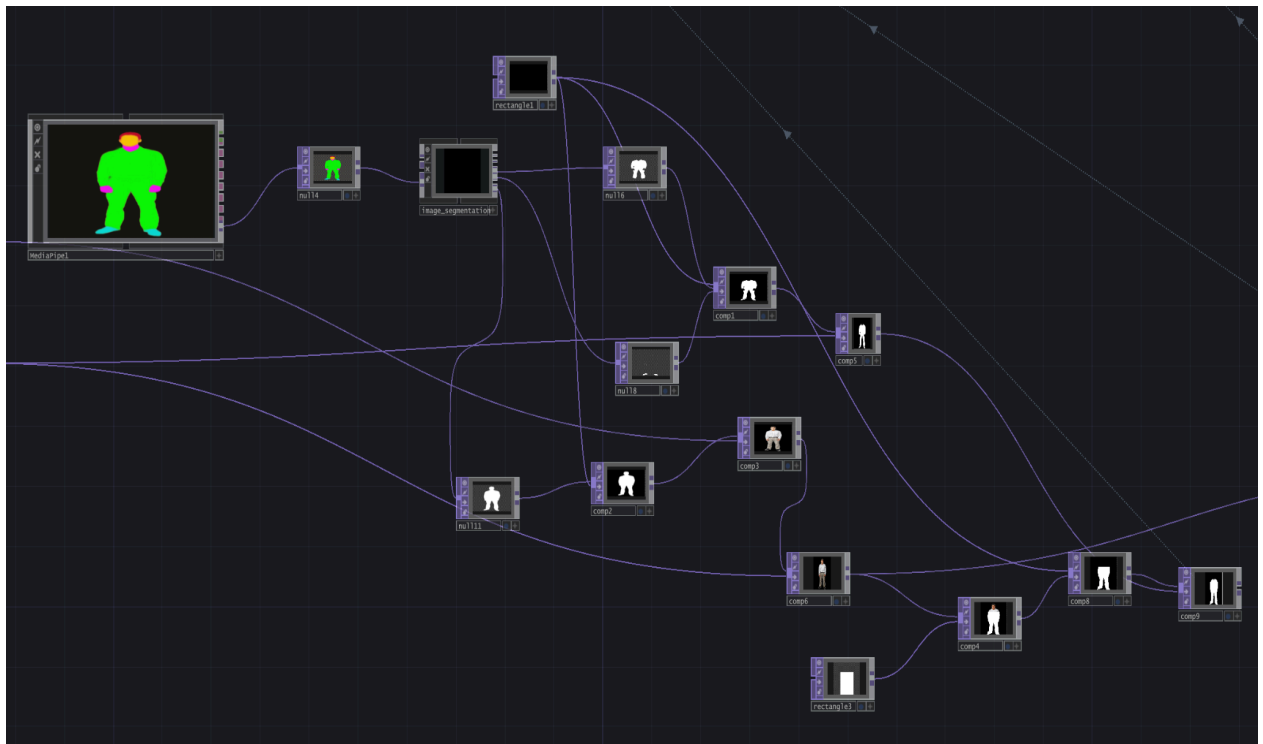
Kohya interface for lora training

- **Inpainting with Stable Diffusion:** To solve the facial identity issue, we used **inpainting** techniques that applied generative changes only to clothing regions — preserving the user’s face and background. This allowed the system to retain identity while rendering new attire realistically.
- **Pose Alignment using ControlNet:** To address the challenge of mismatched clothing poses, we integrated **ControlNet** into the ComfyUI workflow. This allowed the system to guide image generation based on the user’s real-time posture.



ComfyUI-Lora+Inpainting+ControlNet Workflow

- MediaPipe Segmentation:** Facial and background segmentation using **MediaPipe** helped ensure that only the body/clothing area was modified during image synthesis, enhancing both realism and user embodiment.



Touch Designer - Masking

- Real-Time Prompt Switching with ArUco Markers:** We implemented **marker-based**

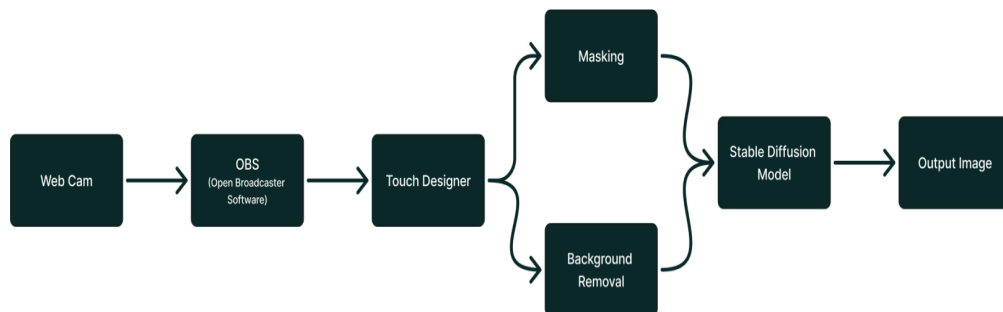
**interaction** using OpenCV and ArUco. Each marker was tied to a historical prompt and LoRA model, allowing users to dynamically switch between eras with a simple physical card.

High-Fidelity Interactive Prototype:

Our final prototype connected multiple technologies to deliver a responsive, immersive system:

- **ComfyUI** managed the Stable Diffusion pipeline, incorporating LoRA models, inpainting, and ControlNet pose conditioning.
- **TouchDesigner** acted as the interaction control panel, linking the camera input and marker detection to the generation pipeline.

### Touch Designer Workflow



- **OBS** (Open Broadcaster Software) was used to present the final composited output on a 36-inch screen. It captured, cropped, and magnified the live feed, giving users clear, real-time feedback on their AI-enhanced appearance.

This full setup allowed users to stand in front of the system, scan a marker card, and experience themselves in authentic, AI-rendered traditional clothing — offering an emotionally engaging and educational digital heritage experience.

## Evaluation and User Testing:

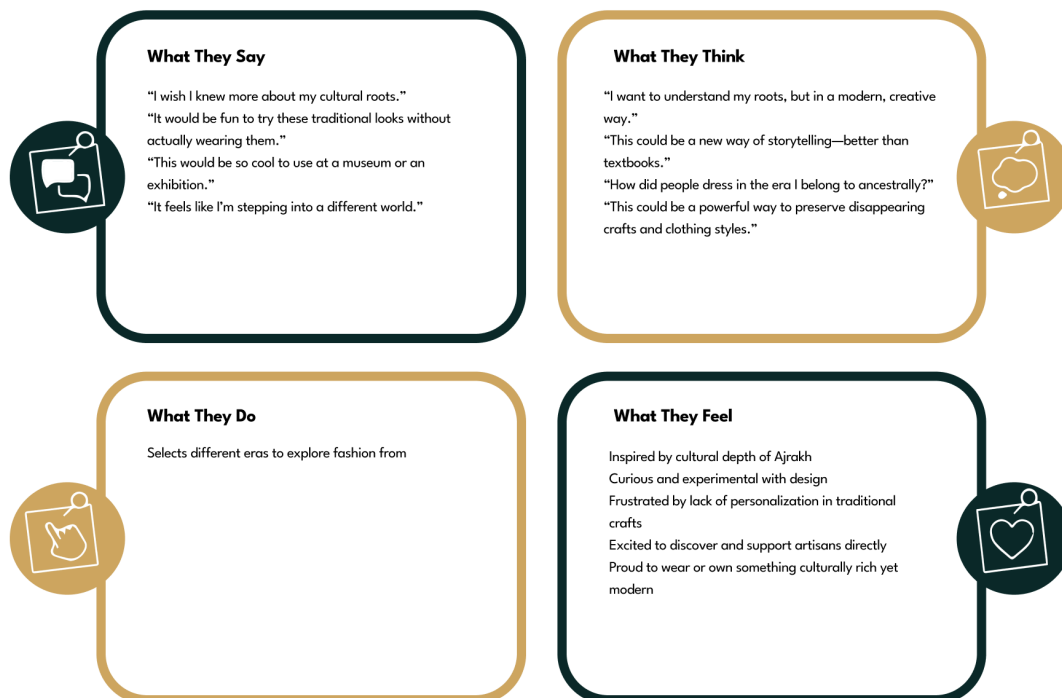
The system was tested informally on other members of the lab, focusing specifically on the visual output of the generative pipeline. Participants reviewed the AI-generated images of traditional Indian clothing produced using **Stable Diffusion with LoRA and ControlNet**. Accordingly, we will either remove it. the toolbar from there or we will reduce its size.

The **marker-based interaction system was not part of this testing phase**. Instead, users were shown generated outputs based on manually triggered prompts corresponding to historical periods.

Based on **verbal feedback**, certain images were perceived as lacking in visual richness or historical detail. In response, the **prompt structures used in Stable Diffusion were refined** — improving garment textures, draping, and cultural symbolism in the final outputs.

Comprehensive empathy mapping was conducted to deeply understand user motivations, emotions, and behaviors—guiding both the design direction and system refinement.

### Empathy Map



This feedback loop informed design refinements and helped move the system closer to deployment-ready fidelity for interactive use.



Image of User and Generated Image side by side.

## Conclusion:

This project explored how generative AI, interaction design, and cultural research can be combined to create immersive experiences for digital heritage education. By reconstructing ancient Indian clothing and overlaying it onto users in real time, the prototype bridged the gap between historical content and modern interaction.

The final system integrated **Stable Diffusion**, **ControlNet**, **LoRA models**, and visual tools like **TouchDesigner** and **OBS**, producing a functional, high-fidelity output that reflects both cultural accuracy and user-centered design.

While the **marker-based interaction system** for one period is functional, testing so far has been limited to generated outputs rather than the full real-time interaction loop. Nevertheless, iterative improvements—guided by internal lab feedback—have significantly improved the realism and quality of the visual experience.

## Takeaway points and Future Work:

The next phase of this project can explore:

- Training **LoRA models for additional historical periods** such as Early Medieval, Mughal-Sultanate, and Colonial India to extend the timeline and cultural depth.
- **Optimizing image generation speed** through model quantization, caching strategies, or faster diffusion frameworks to improve real-time usability.
- Designing a **flexible user interface** that allows users to **manually explore intra-period variations** — such as differences in gender, region, or status — rather than relying solely on marker-based switching.

These directions will enhance the accessibility, richness, and scalability of the system for museum installations, educational contexts, and broader public engagement



## References/Resources Used:

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- <https://sarathitextiles.in/the-evolution-of-dresses-a-historical-perspective/?srsId=AfmBOopJOXiOm7-PBANzZEtAIX8kfzsHxdkml-jHb3lD3Y53jE3Dt0Mt>
- <https://study.com/academy/lesson/the-history-of-fashion-trends-design.html>

PPT Link: [PPT](#)

Video Link: [User\\_testing1.mp4](#)

Google Drive Link: [Project\\_link](#)

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[Dr. Anmol Srivastava](#) for giving us the opportunity to work on this project

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## Contributions:

Name	Roll No.	Contribution
Hariharan Iyer	MT24038	<p>Initiated the project with historical research based on the paper Ramratan Guru et al.</p> <p>Implemented the generative pipeline using ComfyUI, ControlNet, and LoRA.</p> <p>Designed captions for LoRA model training and Created prompt structures for real-time image generation using Stable Diffusion.</p> <p>Trained custom LoRA models for Paleolithic and Indus Valley eras.</p> <p>Integrated <b>MediaPipe</b> for dynamic masking to preserve the user's facial identity and background removal.</p> <p>Developed the ArUco marker detection system, built the marker-to-prompt mapping logic.</p> <p>conducted internal user testing, and led iterative refinement of system outputs.</p> <p>configured the system to work on a 35-inch vertical screen.Integrated OBS to enlarge camera feed.</p>
Prachi Saini	NIFT Gandhinagar	<p>Designed prompt structures for synthetic dataset generation and created the dataset using DALL·E.</p> <p>Conducted a user survey to</p>

		<p>collect insights for era selection and garment relevance.</p> <p>Extended the research into textile materials, draping styles, and material taxonomy.</p> <p>Designed the physical marker cards using ArUco markers.</p>
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