5.12. AR/VR AND SPATIAL UX

What is AR/VR?

Augmented Reality (AR)

- **AR** adds digital content to the user's view of the real world.
- Digital objects can appear over physical surroundings.
- Example:
  - AR navigation
  - Furniture visualization
  - Educational overlays
  - Mobile AR filters

Virtual Reality (VR)

- **VR** creates a computer-generated environment that users can explore and interact with.
- Users are usually immersed in a fully virtual environment.
- Example:
  - VR games
  - Virtual training
  - Simulations
  - Virtual tours

What is Spatial UX?

- **Spatial UX (Spatial User Experience)** is the design of interactions within **3D physical or virtual space**.
- Instead of designing only for a flat screen, designers consider:
  - Depth
  - Distance
  - Position
  - Movement
  - Scale
  - Environment
  - User's physical space

AR, VR & Spatial UX

Technology	Experience
AR	Digital content placed within the real world
VR	Fully simulated digital environment

Technology	Experience
Spatial UX	Interaction designed around 3D space
Mixed Reality (MR)	Digital and physical environments interact more closely

Key Elements of Spatial UX

Space

- Consider where objects and information appear.
- Use physical or virtual surroundings as part of the experience.

Depth

- Use distance and depth to communicate hierarchy.
- Objects can appear near or far from the user.

Scale

- Digital objects should have understandable proportions.
- Incorrect scale can make objects confusing or uncomfortable.

Position

- Place controls and information where users can easily find and interact with them.

Movement

- Consider how users move their:
  - Head
  - Body
  - Hands
  - Viewpoint

Orientation

- Users should understand where they are and how objects relate to their surroundings.

AR/VR Interaction Methods

Gaze

- Users look at an object to select or focus on it.

Hand Gestures

- Users interact using hand movements.
- Examples:
  - Pinching
  - Grabbing
  - Pointing
  - Swiping

Controllers: Physical controllers provide buttons, triggers, and movement controls.

Voice: Users can use spoken commands to interact with virtual environments.

Touch: Some AR experiences allow users to interact through a smartphone or tablet screen.

Body Movement: The system can respond to the user's physical movement.

Spatial UX Design Process

1. **Understand the User:** Identify user goals, abilities, environment, and context.
2. **Define the Experience**
   - Determine what users need to accomplish in the spatial environment.
3. **Design the Space:**
   - Plan the location, scale, depth, and relationships between objects.
4. **Design Interactions:**
   - Decide how users will select, move, manipulate, and control objects.
5. **Prototype:** Create a 3D or interactive prototype.
6. **Test:** Observe users in realistic environments.
7. **Improve:** Refine spatial layout, interactions, comfort, and usability.

Important AR/VR Design Principles

Keep Interactions Natural

- Use familiar gestures and movements.
- Avoid unnecessary complexity.

Provide Clear Feedback

- Show users when an object has been selected, moved, or activated.

Maintain Spatial Awareness

- Help users understand where they are and where important objects are located.

Consider Comfort

- Avoid excessive movement and uncomfortable interaction patterns.
- Give users control over movement and interaction where appropriate.

Use Consistent Interaction: Similar objects should behave in similar ways.

Avoid Information Overload

- Do not fill the user's entire environment with unnecessary information.

Spatial UI Design

Spatial interfaces may include:

- Floating panels
- 3D objects
- Virtual buttons
- Spatial menus

- Information labels
- Environmental indicators
- Virtual navigation controls

Good Spatial UI

- Easy to locate.
- Easy to understand.
- Appropriately sized.
- Clearly separated from other objects.
- Positioned at comfortable viewing and interaction distances.

Navigation in AR/VR:

Physical Navigation: Users move through a real environment.

Virtual Navigation: Users move through a digital environment.

Important Considerations

- Provide clear orientation cues.
- Help users understand their current location.
- Avoid confusing movement controls.
- Provide clear destinations and landmarks.
- Consider physical safety in the user's surroundings.

Accessibility in AR/VR: Design should consider users with different abilities.

Helpful Practices

- Provide multiple interaction methods where possible.
- Support voice and controller alternatives.
- Provide captions and text alternatives.
- Use sufficient visual contrast.
- Avoid relying only on color.
- Allow adjustable text and object sizes.
- Consider users who cannot perform certain physical gestures.
- Provide comfortable interaction options.

Challenges of AR/VR & Spatial UX

Motion Sickness: Rapid movement or mismatched motion can cause discomfort.

Physical Safety: Users may not notice real-world objects while immersed.

Cognitive Load: Too much information can overwhelm users.

Tracking Problems: Poor tracking can cause objects or interactions to behave unexpectedly.

Limited Physical Space: Users may have different room sizes and environmental conditions.

Accessibility: Some interactions may be difficult for users with mobility, vision, hearing, or other accessibility needs.

Example – AR Furniture App

User Goal:

Place a virtual sofa in their living room.

Experience:

Open AR App



Scan the Room



Select Sofa



Place Sofa in Space



Move / Rotate / Resize



View from Different Angles



Save or Purchase

Spatial UX Considerations:

- Sofa should appear at a realistic scale.
- Placement should be easy and predictable.
- Users should receive clear visual feedback.
- Controls should not block the object.
- Users should be able to move around the object naturally.

Benefits of AR/VR & Spatial UX

- Creates immersive experiences.

- Makes complex information easier to visualize.
- Supports interactive learning and training.
- Allows users to explore 3D environments.
- Can improve product visualization.
- Enables new forms of entertainment and communication.
- Provides experiences beyond traditional 2D screens.

5.13. HUMAN-AI INTERACTION ETHICS

What is Human–AI Interaction?

- **Human–AI Interaction (HAI)** focuses on how people **communicate and work with Artificial Intelligence systems**.
- It combines ideas from:
  - User Experience (UX)
  - Human–Computer Interaction (HCI)
  - Artificial Intelligence (AI)
  - Psychology
  - Ethics
- The goal is to create AI systems that are **useful, understandable, safe, and human-centered**.

Examples of Human–AI Interaction

- AI chatbots
- Voice assistants
- Recommendation systems
- AI-powered search
- Smart home systems
- AI design tools
- Autonomous systems
- Healthcare AI
- Educational AI
- Customer-service assistants

Key Principles of Human–AI Interaction

Human-Centered Design

- Design AI around real user needs.
- Understand how people use and interpret AI systems.

Transparency

- Explain what the AI system is doing when appropriate.
- Users should understand important AI-generated decisions or recommendations.

User Control

- Give users control over important actions.
- Allow users to correct, reject, or override AI outputs where appropriate.

Feedback

- Clearly communicate system status.
- Help users understand whether the AI is processing, responding, or unable to complete a task.

Trust

- Build trust through reliable behavior and honest communication.
- Avoid making AI appear more capable or certain than it actually is.

Ethics in Human–AI Interaction

AI ethics focuses on the **responsible development and use of AI systems**.

Fairness

- AI systems should be designed to avoid unjustified discrimination.
- Evaluate systems for potential bias.

Privacy

- Protect personal and sensitive information.
- Collect and use data responsibly.

Transparency

- Clearly communicate when users are interacting with AI.
- Explain important system behavior where feasible.

Accountability

- Organizations and people should remain responsible for how AI systems are designed and used.
- AI should not be treated as the sole decision-maker for important consequences.

Safety

- AI systems should be designed to reduce foreseeable harm.
- Test systems before and after deployment.

Human Oversight

- People should be able to review important AI outputs and decisions.
- Higher-risk applications may require stronger human oversight.

AI Bias

- **AI bias** occurs when an AI system produces systematically unfair or inaccurate results for certain people or groups.
- Bias can enter through:
  - Training data
  - Data collection
  - System design
  - Algorithms
  - Human decisions
  - Deployment context

Reducing Bias

- Use diverse and representative data where appropriate.
- Test AI with different user groups.
- Monitor results after deployment.
- Review unexpected or unequal outcomes.
- Include diverse perspectives during design.

Privacy & Data Protection

AI systems may process large amounts of information.

Important Practices

- Collect only necessary information.
- Clearly communicate how data is used.
- Protect stored data.
- Limit unnecessary access.
- Avoid exposing sensitive information.
- Provide appropriate choices and controls to users.

Key principle:

Use data responsibly and only for legitimate purposes.

Transparency & Explainability

Users should be able to understand important aspects of an AI system.

Transparency Can Include:

- Identifying when AI is being used.
- Explaining what information the system uses.

- Communicating limitations.
- Providing reasons or factors behind important outputs when feasible.
- Clearly distinguishing AI-generated content from human-created content.

Human Oversight

AI should not automatically replace human judgment in every situation.

Human Oversight May Include:

- Reviewing AI recommendations.
- Correcting incorrect outputs.
- Approving important actions.
- Monitoring system performance.
- Providing a way to escalate difficult cases.

Example:

An AI system may **recommend** candidates for a job interview, while qualified people review the recommendations before making decisions.

AI Reliability & Errors

AI can produce:

- Incorrect information.
- Biased outputs.
- Misinterpretations.
- Outdated information.
- **Hallucinations** or fabricated information.

Good Design Practices

- Clearly communicate uncertainty when relevant.
- Give users ways to verify important information.
- Avoid presenting uncertain outputs as guaranteed facts.
- Provide correction and feedback mechanisms.
- Test AI systems regularly.

Anthropomorphism & Emotional Design

Anthropomorphism: Giving AI human-like characteristics, personality, or behavior.

Benefits

- Can make interactions easier to understand.
- May make interfaces feel more natural.

Risks

- Users may believe the AI has human feelings or understanding.
- Users may place excessive trust in the system.
- Users may misunderstand the system's capabilities.

Design principle:

Make AI interactions understandable without misleading users about what the system actually is or can do.

Accessibility & Inclusion

AI systems should be usable by people with different abilities.

Consider:

- Screen-reader compatibility.
- Keyboard accessibility.
- Voice interaction.
- Captions and transcripts.
- Clear and simple language.
- Adjustable interfaces.
- Different communication needs.

Goal: Create AI experiences that **do not unnecessarily exclude users**.

Ethical AI Design Process

1. Understand the Users: Identify users, needs, risks, and contexts.

2. Identify Ethical Risks: Consider privacy, bias, safety, accessibility, and misuse.

3. Design the AI Interaction: Create clear and human-centered interactions.

4. Test: Evaluate accuracy, usability, fairness, and accessibility.

5. Review: Identify unexpected problems and risks.

6. Improve: Modify the system based on evidence and feedback.

7. Monitor: Continue evaluating the system after deployment.

Example: AI Customer Support

User: "I want to cancel my order."

AI: "I can help with that. Your order is eligible for cancellation. Would you like me to cancel it?"

Ethical Considerations:

- **Transparency:** User knows they are interacting with AI.
- **User Control:** User confirms the cancellation.
- **Privacy:** Only necessary order information is used.
- **Accuracy:** The system should provide correct order information.
- **Accessibility:** The interaction should support different user needs.
- **Human Support:** Provide escalation when the AI cannot resolve the issue.

Benefits of Ethical Human–AI Interaction

- Builds appropriate user trust.
- Protects users and their information.
- Reduces potential harm.
- Encourages responsible AI adoption.
- Improves accessibility and inclusion.
- Helps users understand AI limitations.
- Supports better human decision-making.

Common Ethical Challenges

Challenge	Concern
Bias	Unfair or unequal outcomes
Privacy	Misuse or exposure of personal data
Transparency	Users may not understand AI behavior
Accountability	Unclear responsibility for AI outcomes
Safety	AI may cause or contribute to harm
Misinformation	AI may generate incorrect content
Over-reliance	Users may trust AI too much
Accessibility	Some users may be excluded
Manipulation	AI can influence user behavior in inappropriate ways