Scentbound

An olfactory VR game with a custom scent device and a scent–scene matching experiment

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- Keywords: VR, olfactory interaction, game design, speculative world, user study

Research Questions & Design Goals

Practice-based research with Unity, Arduino, and a small scent–scene study.

Research Questions & Design Goals

RQ1 – Scent–Scene Matching

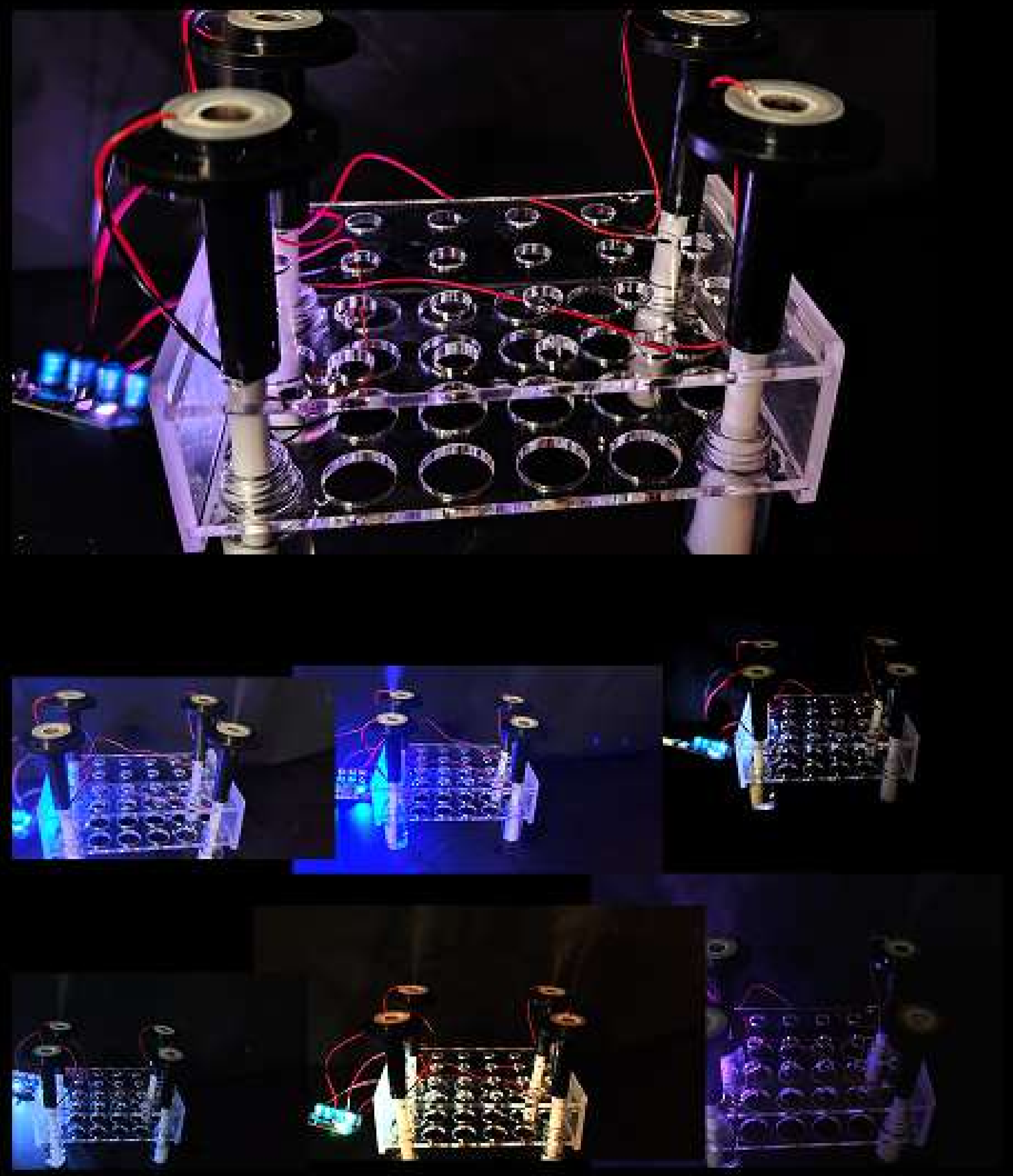
For a set of typical game scenes, how do players subjectively map different scents to each scene?

RQ2 – Design Insights

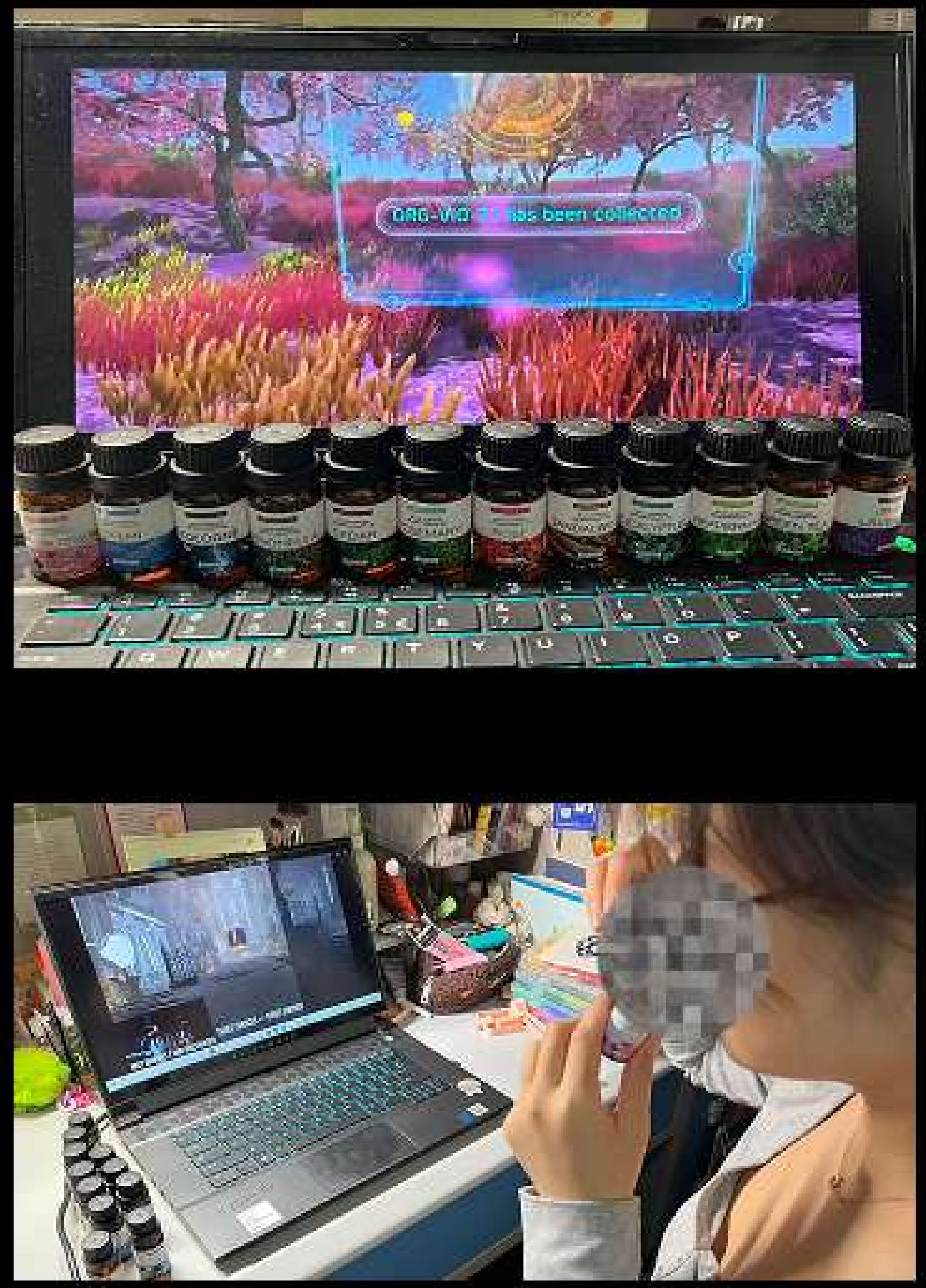
What practical guidelines for olfactory game design can be drawn from how players match scents to scenes and describe their experience?

Research Questions & Design Goals

VR Game



Scent hardware



User Study

DG1 – Olfactory world-building
DG2 – Scent in archetypal scenes
DG3 – Practical scent hardware
DG4 – Scent–scene mapping study

How related work usually studies smell?

What smell does ?

What are the key challenges?

Related Work

What is the current state of research on olfactory interaction in HCI?

What is the research gap?

Yang, V. 2025. Virtual Reality: A Study About Olfactory Senses in Immersive Learning. Intersect.
Elsabbagh, N. et al. 2023. Combining scent and sound for guided meditation in virtual reality. Mobile Networks and Applications.
Zhang, Y. et al. 2024. Advances in olfactory augmented virtual reality. Nature Communications.

Related Work

Effects of Smell

Smell uniquely links to strong memory and emotion.

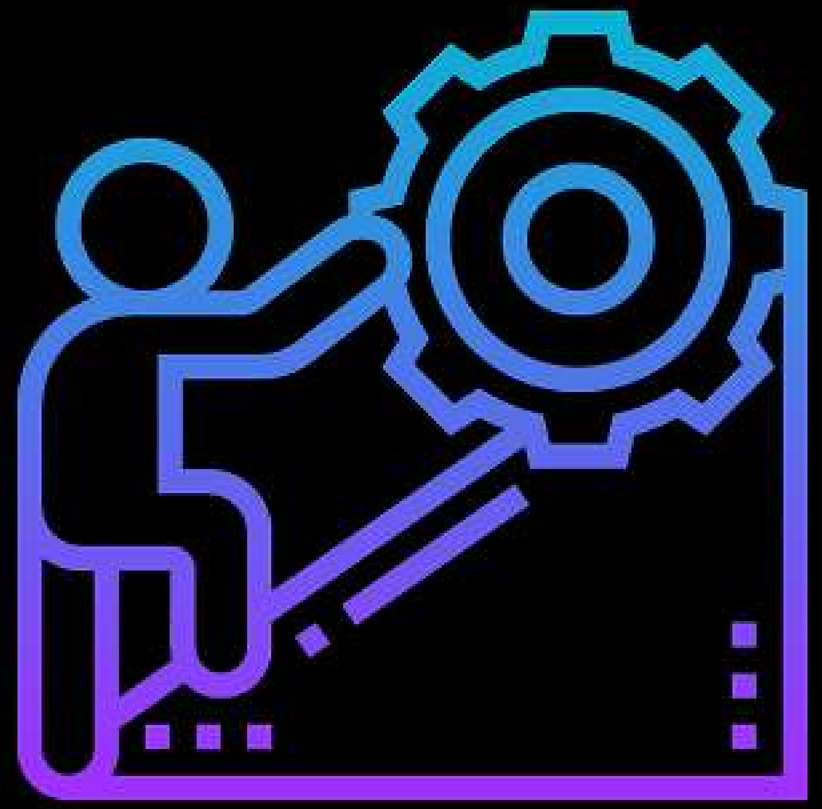
In VR games, strategic scent addition boosts presence and emotional engagement.

Challenges of Olfactory Interaction

Timing: Slow diffusion, lingering; sync difficulty.

Hardware: Bulky, complex, costly; impractical for mass VR/games.

Users: High variability (perception); usability/ethical issues.



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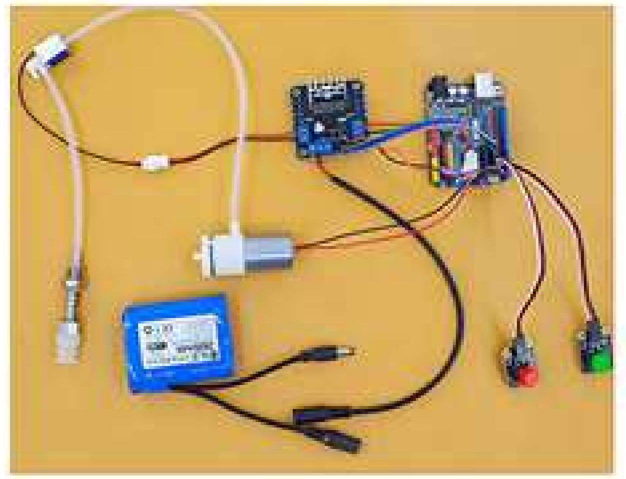
Related Work

Use cases

VR learning, meditation, memory care, olfactory art

Device types



Device principle	Control method	Scent source
Arduino + valve diffuser	Serial ON/OFF from Unity / VR	Essential oil bottle
Arduino + air-pump + tubes	Switch active channel	Scent boxes
Candle + fan	Manual, no sync	Scented candle
Wearable / flexible micro-diffuser	Custom chip, near-nose driver	Micro liquid capsules

Gap

Scent is rarely a core mechanic (mostly an add-on).
Empirical data is lacking on scent-to-scene mapping.
Affordable, reproducible multi-scent hardware is scarce.

Research Method

This project adopts a practice-oriented mixed research approach, grounded in practice-based and research-through-design traditions in HCI

Build: Unity VR game + 4-channel Arduino scent device

Test: 4 participants, scent–scene matching with 12 anonymised scents

Measure: 7-point ratings (match, emotion, immersion) + short interviews

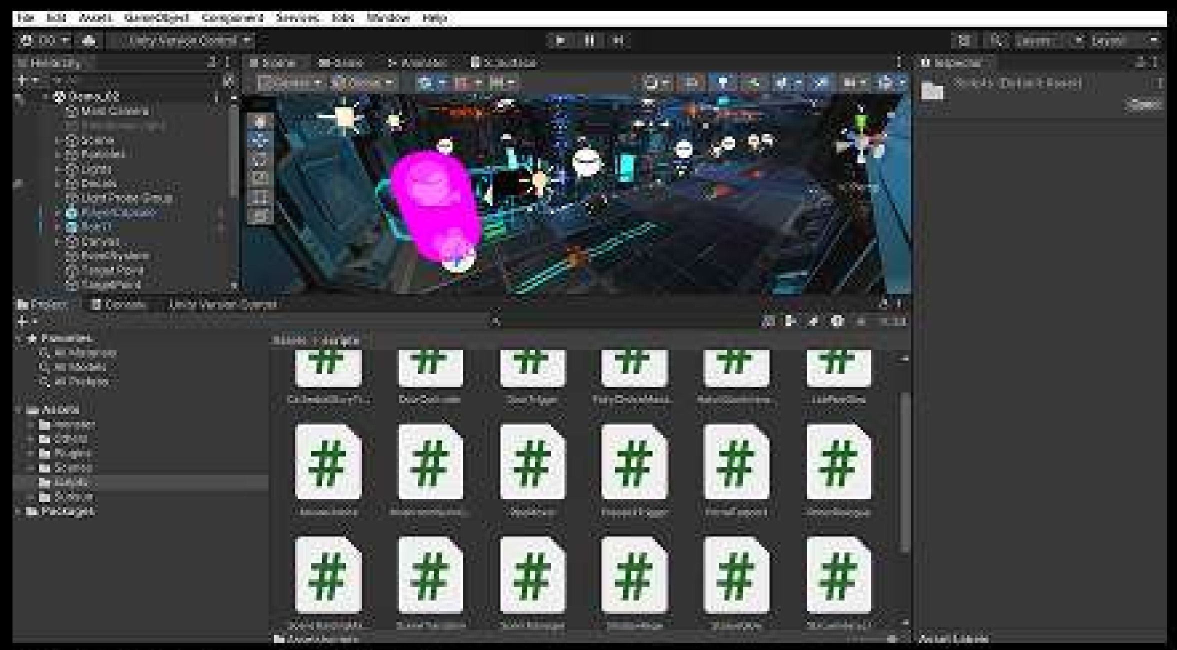
Analyse: descriptive stats + simple thematic coding

John Zimmerman, Jodi Forlizzi, and Shelley Evenson. 2007. Research Through Design as a Method for Interaction Design Research in HCI. In Proceedings of the SIGCHI Conference on Human Factors in Computing Systems. ACM, 493–502. doi:10.1145/1240624.1240704

Implementation & Result

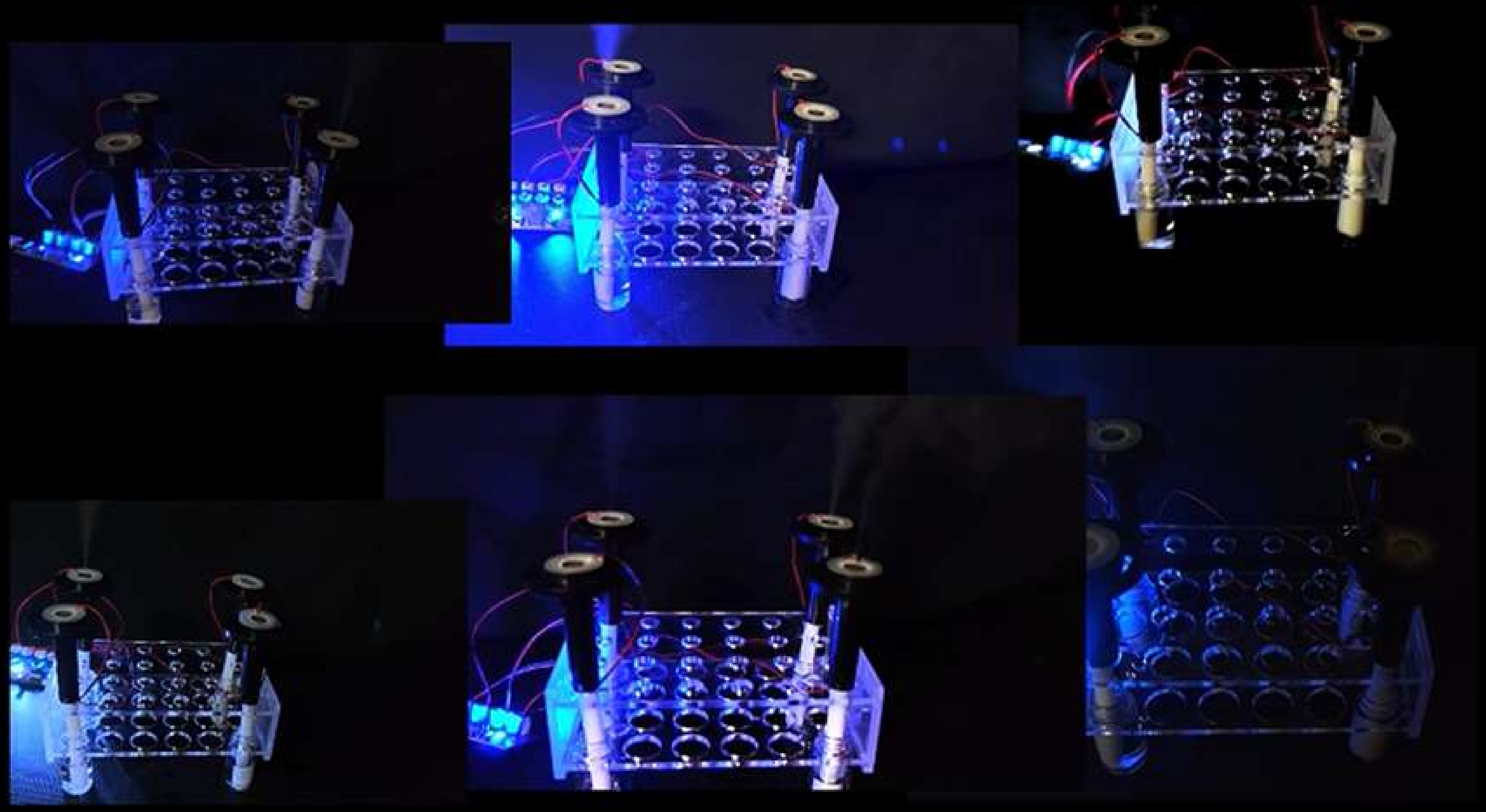
Implementation（Game + Hardware + Study）

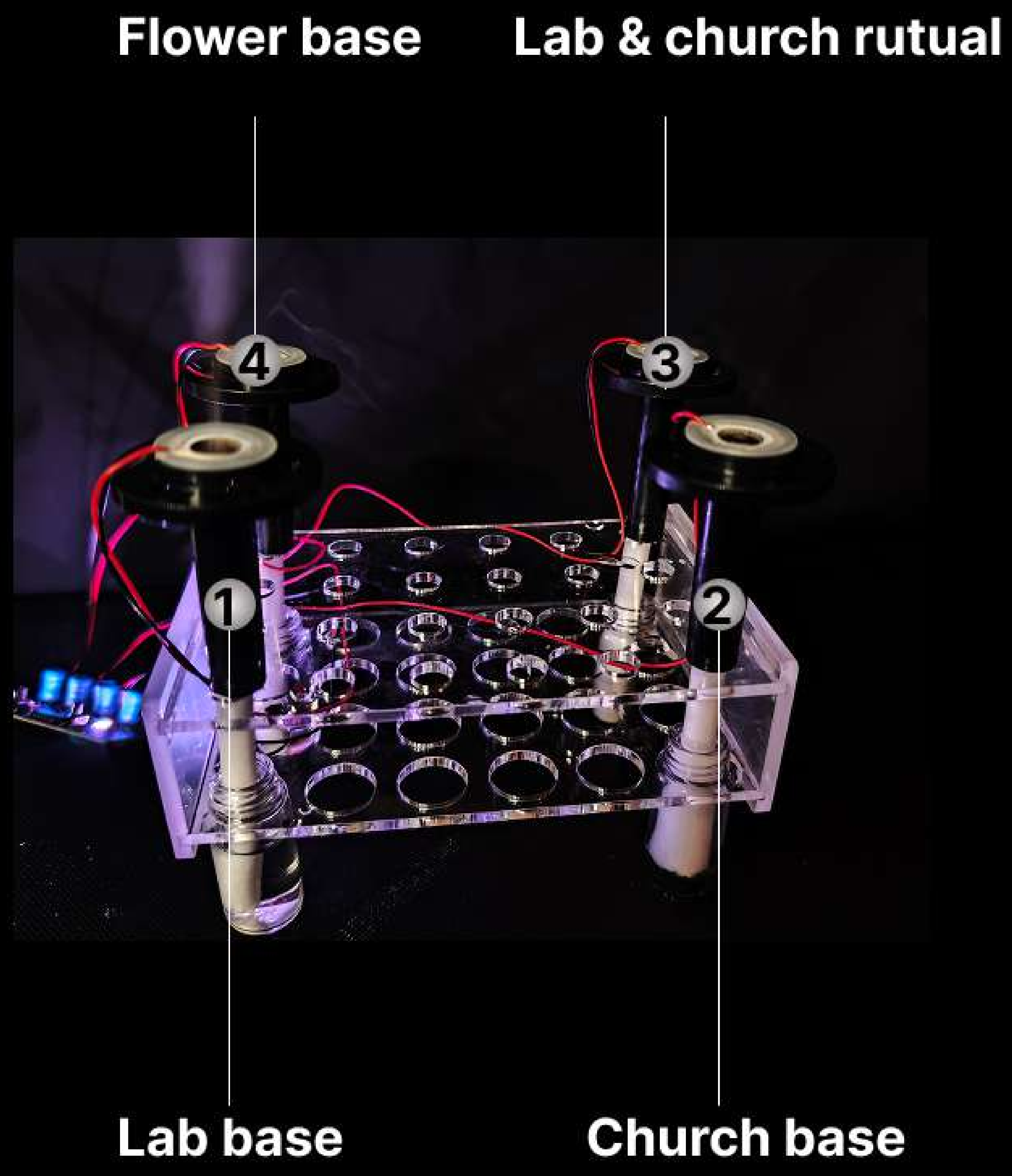
Unity Implementation



Scene	Key Structures	Main Function	Interaction Mechanic	Main Scripts & Logic (short)
Cyber Lab	Pipe system, beam tower, robot, hatch door, reactor	Intro & tutorial area; player fixes the lab to unlock the teleport to the garden	Triggered dialogue, press E to repair, VFX feedback, door opening	RobotDialogue.cs – triggers intro dialogue + UI; PipeMover.cs – moves pipe when player presses E; LabPipeGlow.cs – plays beam / particle effect after repair; HatchDoorInteract.cs – checks distance and opens hatch with E; SceneTransition.cs – activates teleport and loads next scene.
Spring Garden	Flower spirit, mushroom creatures, rhythm area, wind & petal particles	Rhythm mini-game; resonate with creatures to collect "emotion shards"	Rhythm judgement, flashing cues, key press response, resonance feedback	MushroomSyncGame.cs – reads three-step light pattern and checks Q/E/Space input; ShadowRage.cs – failure VFX (flash / glow); NextMonsterTarget.cs – guides player to next creature / portal; MouseUnlock.cs – unlocks area after successful rhythm.
Frozen Church	Three statues, three fairies, guiding light paths, altar	Player chooses a moral tendency and triggers one of three endings after praying	Fairy selection (keys 1/2/3), path following, press E to pray, branching endings	FairyTrigger.cs – enables choice UI when player enters area; FairyChoiceManager.cs – stores choice and moves fairy along path; StatueInteract.cs – handles prayer with E; StatueGlow.cs – makes statue glow after prayer; PortalTeleport.cs – teleports back to lab according to ending.
Return to Lab (Endings)	Three zones (flower, rage, leaving), ending-specific particle effects	Visualise different endings based on the player's choice in the church	Teleport, effect playback, narration / UI display	Scene1EndingManager.cs – reads choice ID (1/2/3) and activates the corresponding zone; PopupUITrigger.cs – shows ending text / subtitles; particleTrigger.cs – plays smoke / explosion / pollen particles; SceneTransition.cs – optionally return to title or restart.

Implementation（Game + Hardware + Study）





- 4 HE-30 nebuliser modules + 4 scent bottles
- Power, MOSFET control from Arduino pins
- Simple serial protocol from Unity

Implementation（Game + Hardware + Study）

User Study






- N = 4, 12 anonymised scents (S1–S12)
- Step 1 – Pre-classification
- Smell 12 bottles; tick which scenes they could fit
- Step 2 – In-scene rating
- Watch 3 scene clips; rate only the scents they picked for that scene
- 7-point scales: match, valence, arousal, immersion
- Step 3 – Mini-interview
- “Why does this scent fit or not fit this scene?”

Implementation（Game + Hardware + Study）

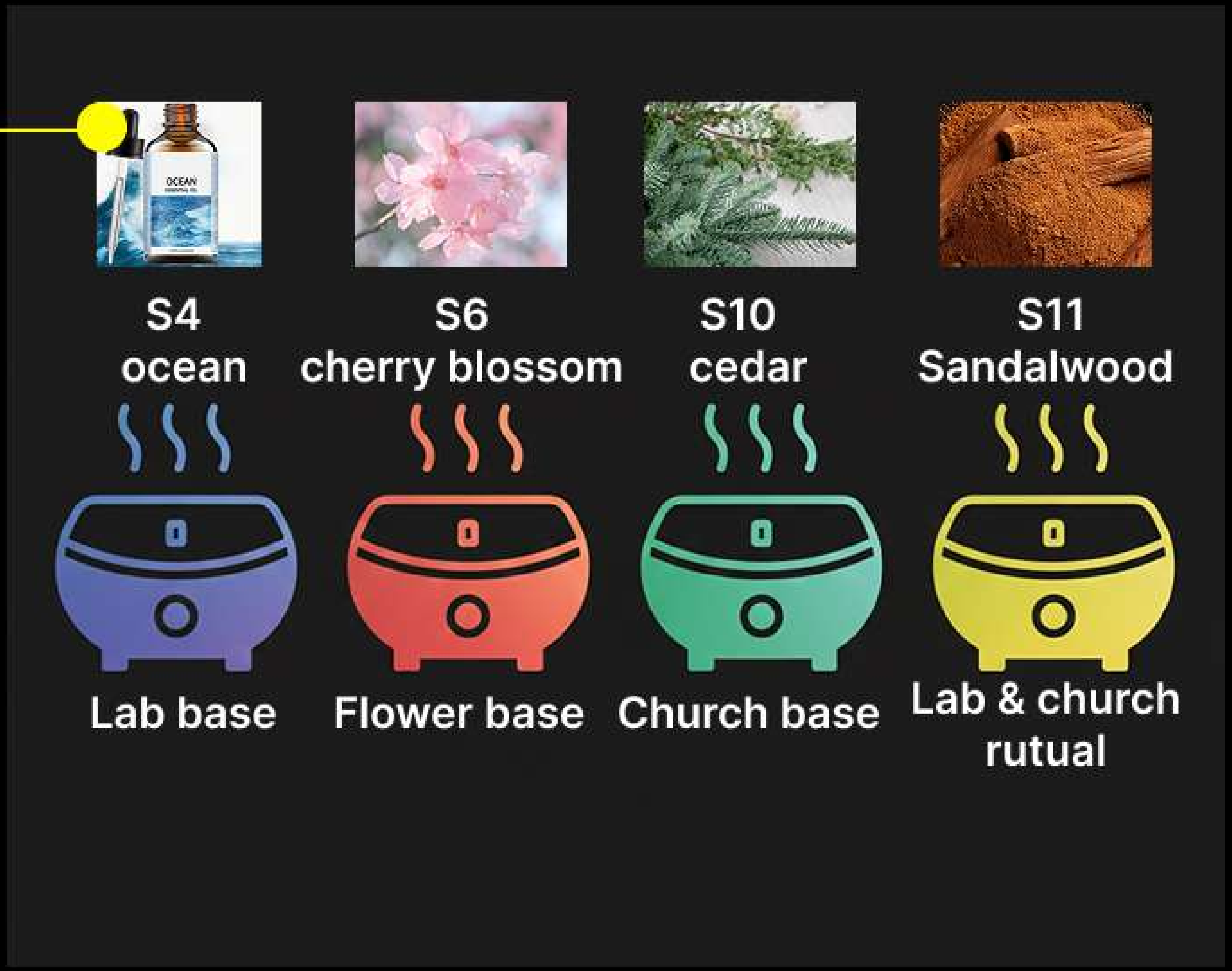
User Study

Table 1: Key scent–scene combinations and rating ranges.

Scene	Scent ID	Rating range (1–7)	Note
Lab	S4	5–7	Consistently judged as fitting the lab ambience.
Lab	S3	4–6	Sometimes chosen as a sharp, “chemical” lab note.
Garden	S6	6–7	Widely seen as a prototypical flower-field scent.
Garden	S5	3–5	Occasionally chosen; often linked to bedroom or aromatherapy rather than an outdoor field.
Garden	S7	5–7	Frequently chosen as a romantic, idealised floral.
Church	S10	6–7	Consistently judged as a typical church/woody interior scent.
	S11	5–7	Often described as an incense or ritual smoke layer.

User interview coding

#Note: The oceanic aroma is composed of: High concentrations of synthetic aldehydes/aquatic molecules (Calone and Helional), along with minor additions of cedarwood and menthol.



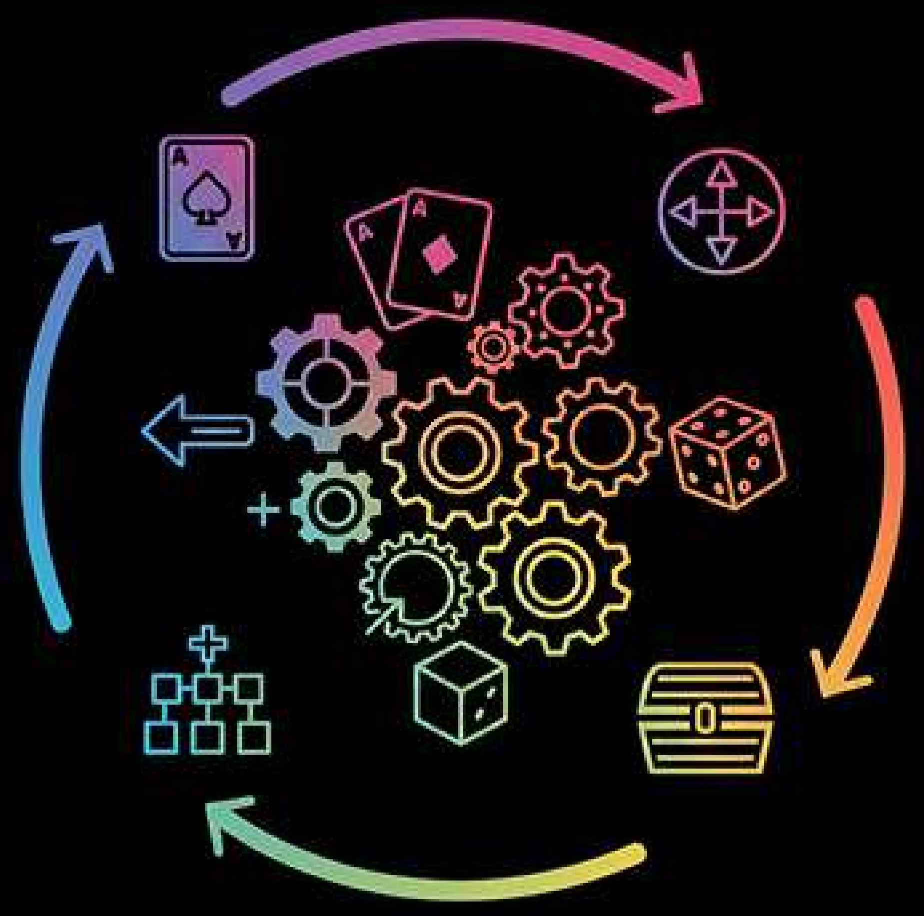
Result

The elements in the accompanying image were generated by Gemini.

Future work

More diverse participants and scenes

Personalised scent profiles



Deeper game mechanics

The elements in the accompanying image were generated by Gemini.