Holonomy

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What is Holonomy?

- Holonomy is a Virtual Reality (VR) game in which a player attempts to navigate through **a hyperbolic space while staying within a 3x3** meter Euclidean space [2].
- Figure 2 shows the game from the player's perspective. Around the left of the pillar, a river can be seen but around the right, the objective can be found. This difference is caused by the hyperbolic space.
- Players navigate this space with help from a minimap, shown in Figure 3.

What is Hyberbolic Space?

- This **hyperbolic space** consists of **square rooms.**
- On the corners of each room, five square rooms come together.
- In this game, **a circle consists of 450 degrees**. To walk a circle, you must take five 90-degree turns around a pillar.
- The difference between the real world and the virtual space can be seen in Figure 1. Keep in mind that in both rows each turn is a 90-degree turn and each space is a square.
- You can see that from step 1 to step 3 (in Figure 1) the player walks a full circle in the virtual world while appearing to be one step further in the normal world. While walking a full circle in the virtual space you can also see that the player's orientation between the real and virtual space has changed by 90 degrees.

Why a Virtual Reality Game?

- The holonomy team has been developing a game that allows players to navigate through rooms connected by hyperbolic geometry, see Figure 1.
- While **navigating an unknown** space can already be difficult, this difficulty only increases when the player finds themselves in a non-Euclidean space.
- Virtual reality (VR) is widely used to teach complex topics [1]. VR allows players to explore and understand the space. An additional benefit is that, because of the hyperbolic space in VR, a player can walk infinite distances in the virtual world while only staying within a 3mx3m room.

References

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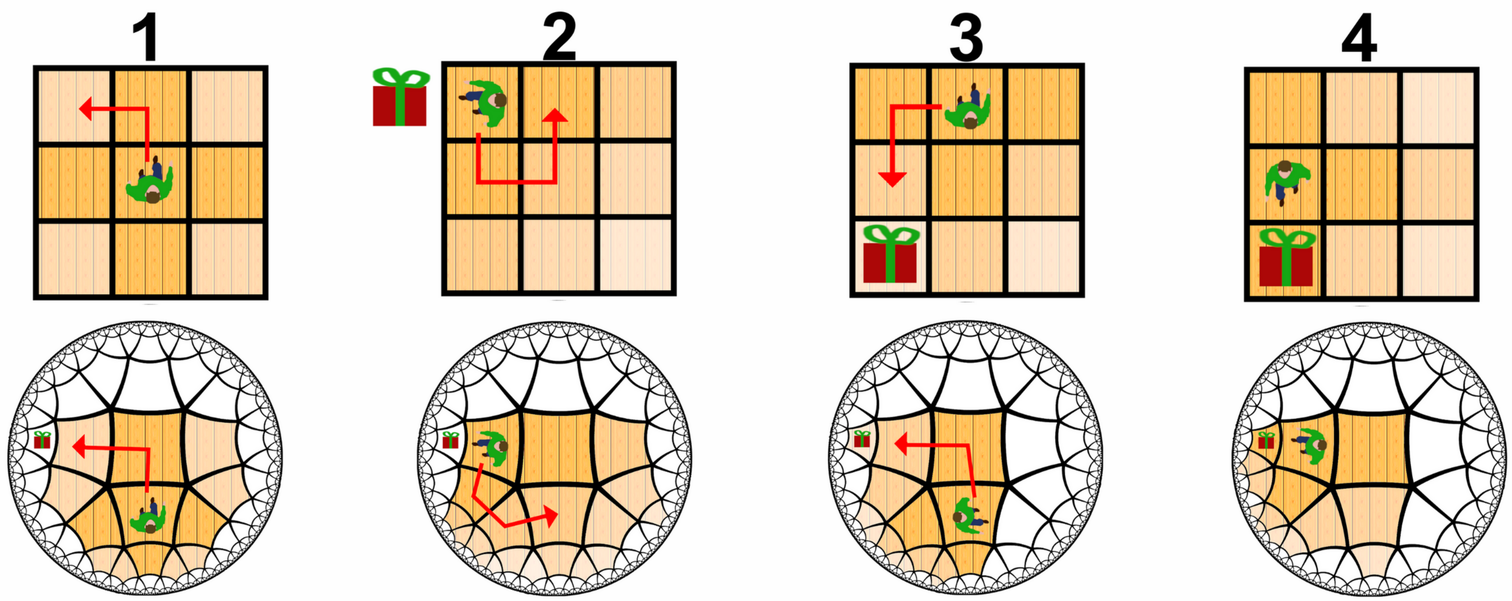

Figure 1: Real world (Top) vs hyperbolic movement in VR (Bottom)

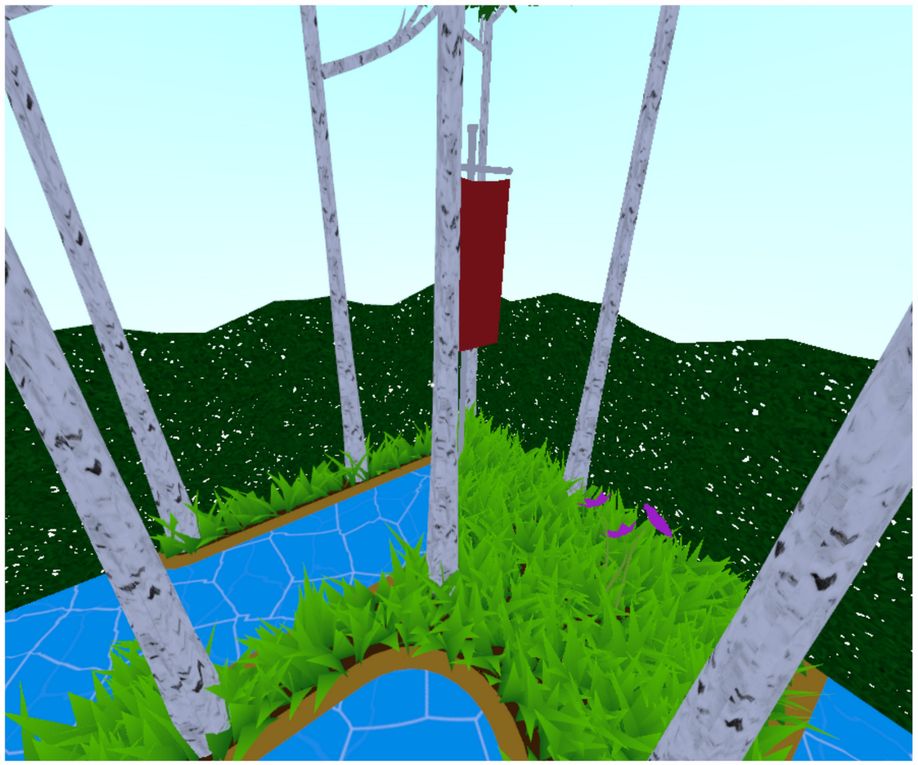

Figure 2: An example of the visible 3x3 grid in the VR world

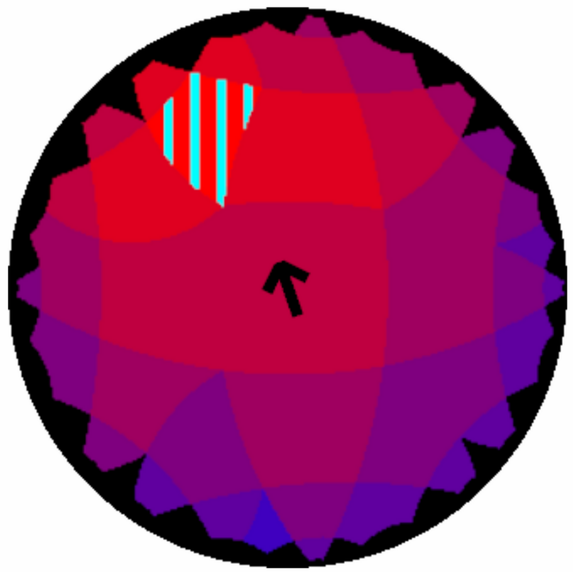

Figure 3: The minimap of holonomy. It uses a Hot-Cold colouring to help the player navigate toward the objectives. And the objectives are represented by striped squares.