THE HYPERCUBE

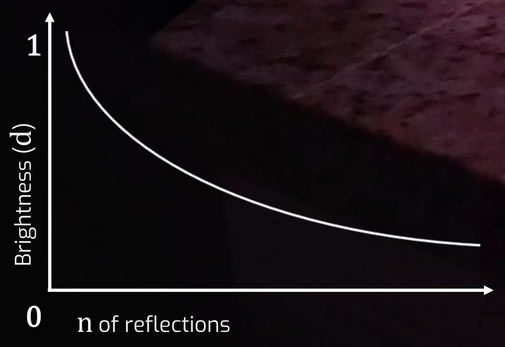
Joep Eijkemans
Art, Mathematics & Technology
University of Twente

This mesmerizing piece is called The Hypercube. Aesthetics were clearly prioritized over mathematical complexity when it was designed. The cube is a very basic shape, and very easy to work with. Despite this, mathematical principles like Geometry, Infinity, Symmetry & Mirroring are somewhat relevant for this art piece. The cube essentially copies itself into infinity, but becomes increasingly dim doing so.

The brightness of a reflected cube can be calculated using the formula:

$$I_n = I_0 * d^n$$

Where I_n is the brightness of a certain reflected cube, I_0 is the brightness of the light emitted by the LEDs inside the cube, d is the reflection factor (0-1), and n is number of cubes reflected. The formula takes the shape of an asymptote.



The frame is constructed using 4mm thick lasercut wood. Each side of the Hypercube is made of plexiglass covered with semi-reflective foil, essentially creating a semi-transparent mirror.

For this reason, each reflection is the mirrored version of the cube before it: The mirroring is in the direction in which the cube is adjacent relative to the one it reflects. The reflection of the cube downwards is mirrored on the vertical axis, but the reflection of the cube sideways is mirrored on the horizontal axis.

The inside of each edge of the cube is decorated with LED lights (ws2812b, 60 LED/m), which are held in place using 3D printed parts. Only a portion of the light radiated from these LEDs can pass through the walls, whilst the remainder is reflected back into the Hypercube. The light that has been reflected will encounter another wall, where a portion of it shines through, whilst the rest is reflected again. And again, and again.

This process essentially repeats infinitely, since no matter how many times you multiply any number with the reflection factor (the percentage of light that is reflected back into the cube), it will never reach zero. However, at some point the light becomes too dim to see.