

The Light-Box: An interactive real-time data visualisation cube display

This project presents the ‘Light-Box’, an interactive, 5-panel RGB LED cube, invented as a both a piece of creative lighting, and as dynamic data visualisation tool. The primary aim was to move beyond traditional flat-screen interfaces by developing a tangible, interactive 3-dimensional display, which transforms live environmental data into an engaging, immersive experience. The system consists of four main visual modes, each facing several different computational challenges. The Weather and Time modes demonstrated a tangible user interface (TUI), the Koi Pond mode highlighted an aesthetically pleasing interactive simulation, and the Fire mode showcased its ability to act as an ambient lighting installation.

The system was developed using a legacy Raspberry Pi 2B to drive five 64x64 LED matrices, with custom rendering engines built in Python using the Pillow library to display high-fidelity weather animations (see Figure 1), a minimalist local clock mode (see Figure 2), an aquarium-like Koi Pond simulation (see Figure 3) and an ambient fire mode (see Figure 4). Physical interaction was achieved by integrating a BBC micro:bit V2 as the accelerometer, allowing users to navigate data for different global city locations via tilting gestures, toggle display modes through shaking and turning the artefact on/off by resting it on its side.

A working prototype was tested via a small-scale user study, consisting of ten minutes interacting with the device, followed by a semi-structured interview and an anonymous questionnaire. The user study identified a clear usability bottleneck. The data from the user study revealed a significant performance gap between the “Tilt” (4.80/5) and “Shake” (2.60/5) gestures, suggesting that the weight and mass of the cube interfered with the user’s ability to change mode. Despite this, the Light-Box still achieved an 80% preference for ‘using this artefact over a smartphone app as a data visualisation tool’. It suggests that the tactile 3D structure of the device provided a level of engagement that a 2D display cannot replicate. This is supported by the qualitative feedback, where users described the interaction as “novel,” “satisfying,” and “immersive”. A user even compared the most popular Koi Pond mode (60%) to “having a real fish tank”, a strong validation towards the device naturally blending into the home environment.

The final results demonstrated that legacy hardware can be effectively repurposed to drive an interactive, real-time data visualisation tool. The Light-Box offers a scalable framework for future work in interactive, low-resolution pixel-art displays and physical computing.



Figure 1:
Weather Mode



Figure 2:
Time Mode

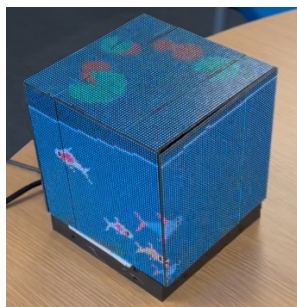


Figure 3:
Koi Pond Mode



Figure 4:
Fire Mode