Luciolinae

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Artistic concept

Luciolinae evokes the mating songs of humpback whales, or the bellowing of shipping freighters drifting through a bay on a foggy night. The signals passing back and forth between the Luciolinae are primal utterances of presence. Their utterances are so much a part of their being that the utterances and the beings are nearly not worth speaking of in separate terms: they are entities whose only function seems to be to communicate amongst themselves.

As viewers we observe them, like microbes in a petri dish. Their technological nature and aesthetic are reminders to us that we are the universe observing itself. Though their utterances are foreign and artificial, they bear as much relation to us as humans as to the technology that spawned them. Though we do not understand their language, we can watch it play out its patterns. These patterns of utterance give an impression analogous to the kind of mental model from which language first emerged.

Realisation

Luciolinae requires a dark space of at least 30 sq.m. for exhibition. The physical hardware consists of a variable number of LED lighting devices, organised into groups of up to 16 individual elements; modular control electronics; a power and communications network; and a central sequencing hub.

LED lighting devices

LED lights are organised into groups of hierarchical structures. At the base is of each group is a single Cree XLamp XR-E Royal Blue LED mounted on a star-shaped heat-sink, drawing 1000mA of current at peak, which is suspended 1200-1500mm above floor level. Up to fifteen 5mm Royal Blue LEDs drawing 10-15mA of peak current are arranged around and above this base LED, forming an inverted root-like structure rising to 3000-4000mm above floor level *(Figure 1)*.

The LEDs are suspended from an overhead truss structure with nylon monofilament. At the very base of this tree structure, 1000mm above floor height, is suspended a 500mm x 500mm square of semi-transparent white 5mm thick Plexiglas, which acts as a diffusion surface for the Cree XLamp.

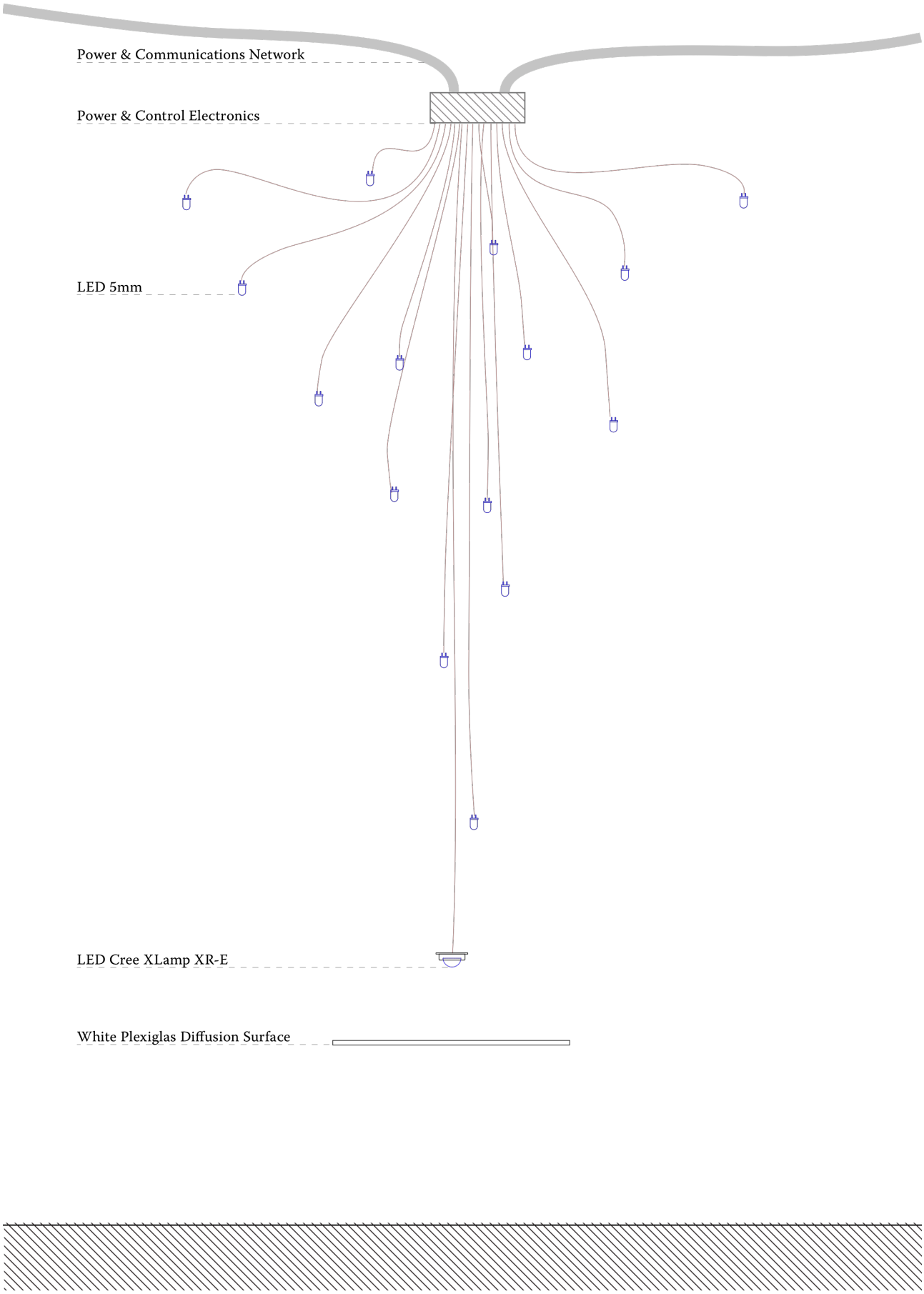


Figure 1: A group of one Cree XLamp XR-E and fifteen 5mm LEDs, with supporting hardware.

Central Sequencing Hub

The accompanying sound and the individual control instructions for each light is provided by a Beagle Board based system running GNU/Linux (Ubuntu 9.10). The control/sequencing software itself is a headerless openFrameworks-derived application. Pure Data source code is incorporated into the application, which runs an instance of the Pure Data synthesis engine to generate the soundtrack.

Sequencing

The sequencing engine is a generative system that runs an independent Markov chain for every group of one Cree + fifteen 5mm LEDs. The exhibition chain has four states, each of which plays out a generative animation sequence *(Figure 2)*:

1) Sleep (no effect)
2) Gather (5mm LEDs briefly illuminated in contracting rings centred on the Cree LED)
3) Pulse (Cree briefly illuminated at full power)
4) Release (5mm LEDs briefly illuminated in expanding rings centred on the Cree LED)

The expanding and contracting rings in the Gather and Release states are intended to give the impression that a large amount of energy is being collected (Gather) and then dispersed (Release), with the focal point for collection being the Cree LED at the base of the group. The precise mapping between conceptual rings in the software and electrical illumination of a given LED is determined by a Delaunay triangulation of a pre-calculated 2D projection of the positions of the LED lights in the exhibition space. For this purpose a number of other states in the Markov chain are available to an operator when installing the piece for the purposes of locating each LED by its channel number and positioning it in the Delaunay space. These calibration states are not available when the software is running in exhibition mode.

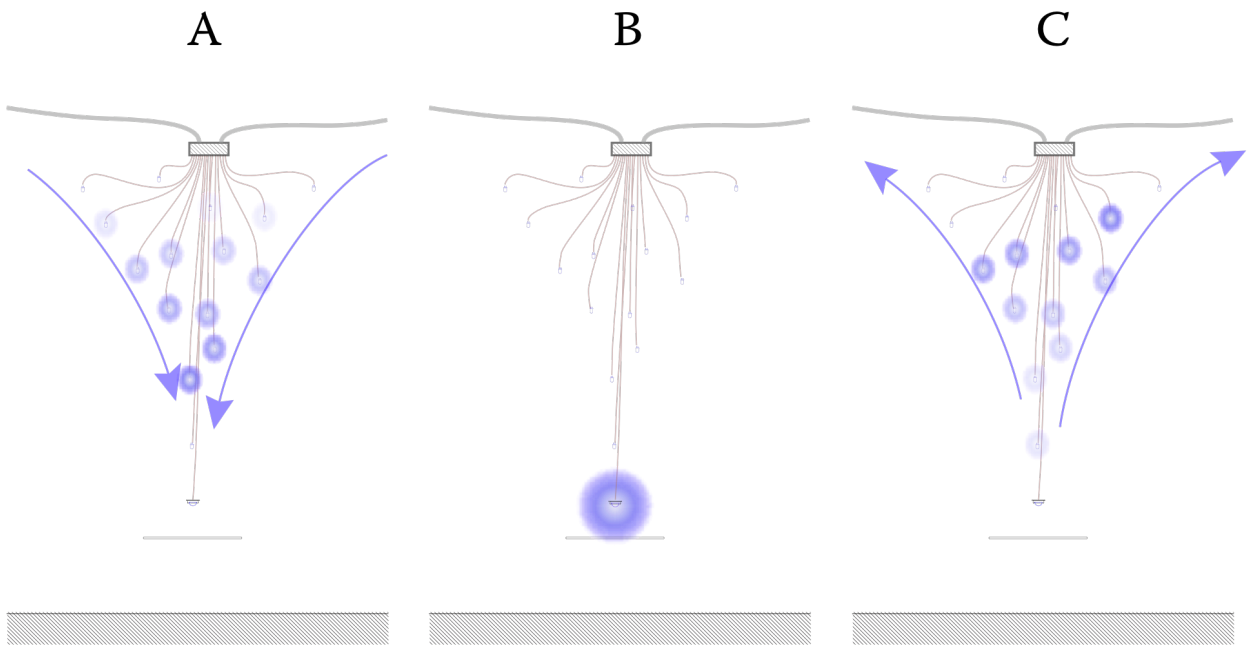


Figure 2: States in the Markov chain used to generate the illumination sequence. A: Gather; B: Pulse; C: Release.

Sound

With the exception of a background drone, sound follows the illumination of individual LEDs.

When a 5mm LED is illuminated, the sound engine produces a very brief tone impulse, with a pitch randomly selected between 6000 and 12000Hz *(Figure 3)*. This tone is positioned (panned) in sonic space using positioning information derived from the calibration of the sequencing engine, and then fed into a reverb with long damping time, implemented as a feedback delay network *(Figure 4)*.

When a Cree XLamp LED is illuminated, the sound engine produces a short 960Hz tone, synchronised precisely with the brief illumination of the LED *(Figure 5)*.

The background drone is provided by five sine wave oscillators operating at 40.21Hz, 40.5Hz, 80Hz, 120.3Hz, and 160.31Hz. The oscillators are amplitude-modulated with each other and recursively with the products of the amplitude-modulation to produce a rich tone *(Figure 6).* A slowly and randomly oscillating modulation derived from within the light sequencing engine further modulates the drone over longer periods of time.

Modular Control Electronics

Control for each group of fifteen 5mm LEDs + one Cree LED is built around the Texas Instruments TLC5940 16 channel 12 bit PWM LED Driver, slaved to an Atmel ATtiny2313 microprocessor *(Figure 7).* Each output channel is accessible via a Molex Spox 2.5mm header socket. Current boost for the Cree is handled by a separately-powered breakout box, which connects to the Molex Spox socket. Communication is provided by a standard single-channel RS485 driver (STMicroelectronics ST485). Two 4-pin standard Molex sockets are provided for power and communications pass-through.

Power and Communications network

Power is provided by a single 12V DC rail supplying up to 15A peak current. Communications between the Central Sequencing Hub and each of the Modular Control Electronics units is provided by a 4-core power/data cable. The network has a basic point-to-point topology.

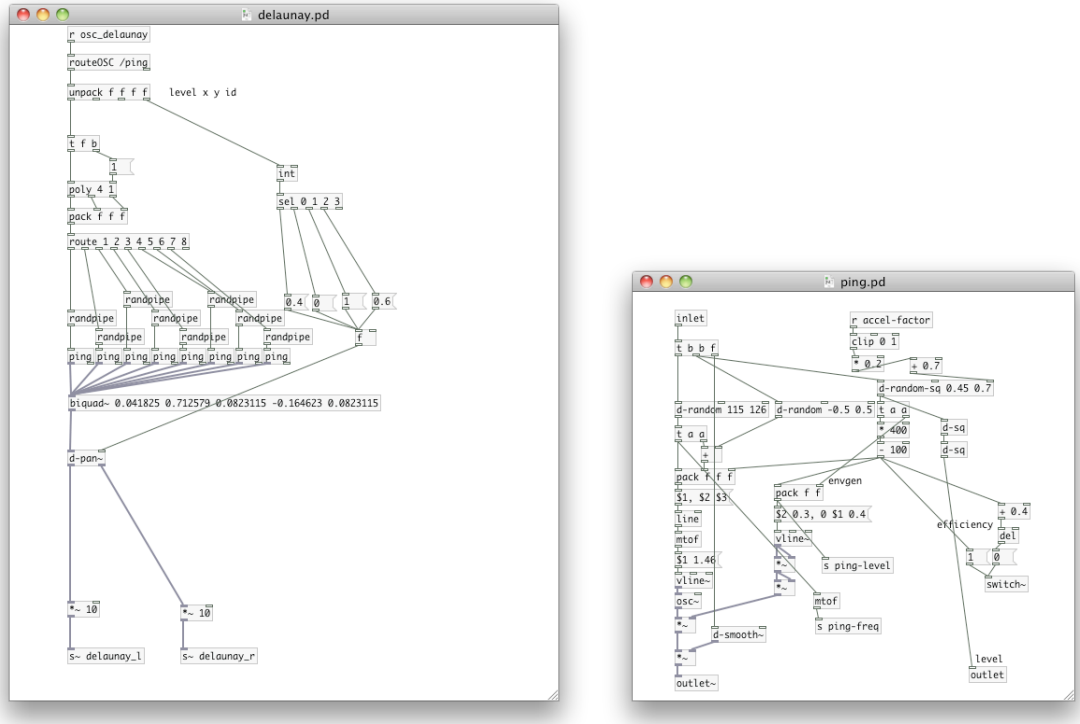


Figure 3: Sound generation for the 5mm LEDs.

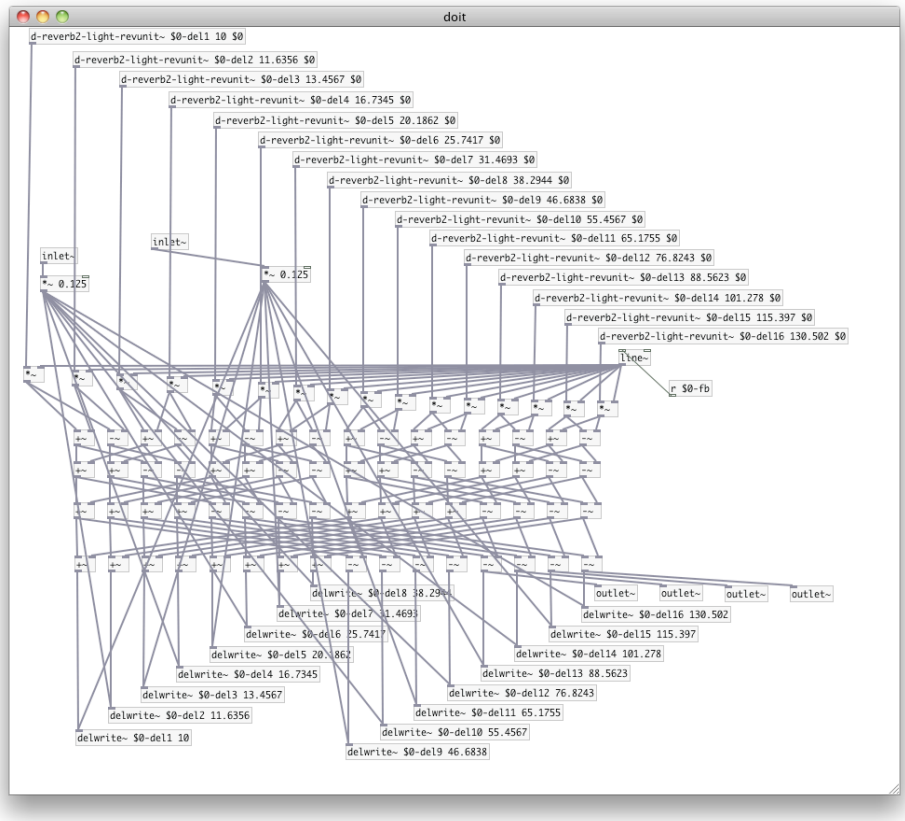
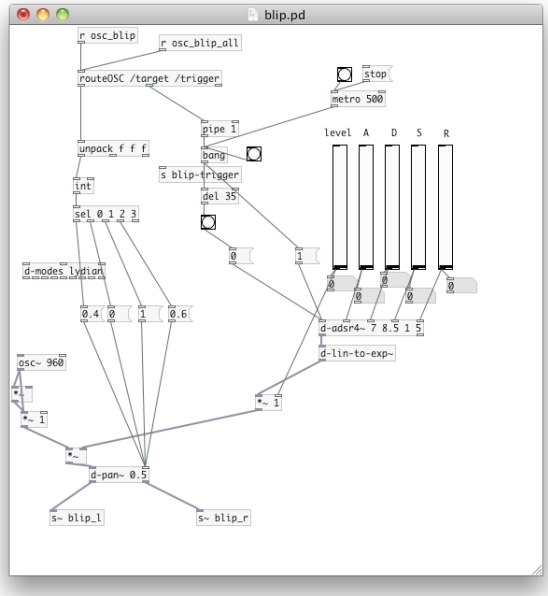


Figure 4: Feedback delay network reverb.



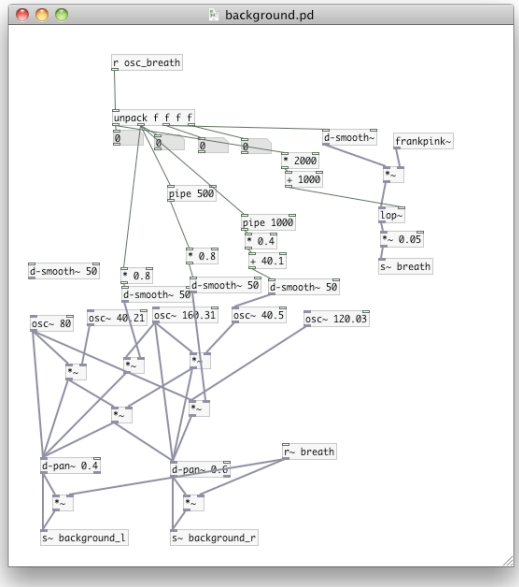


Figure 5: Sound generation for the Cree LEDs. *Figure 6: Background drone.*

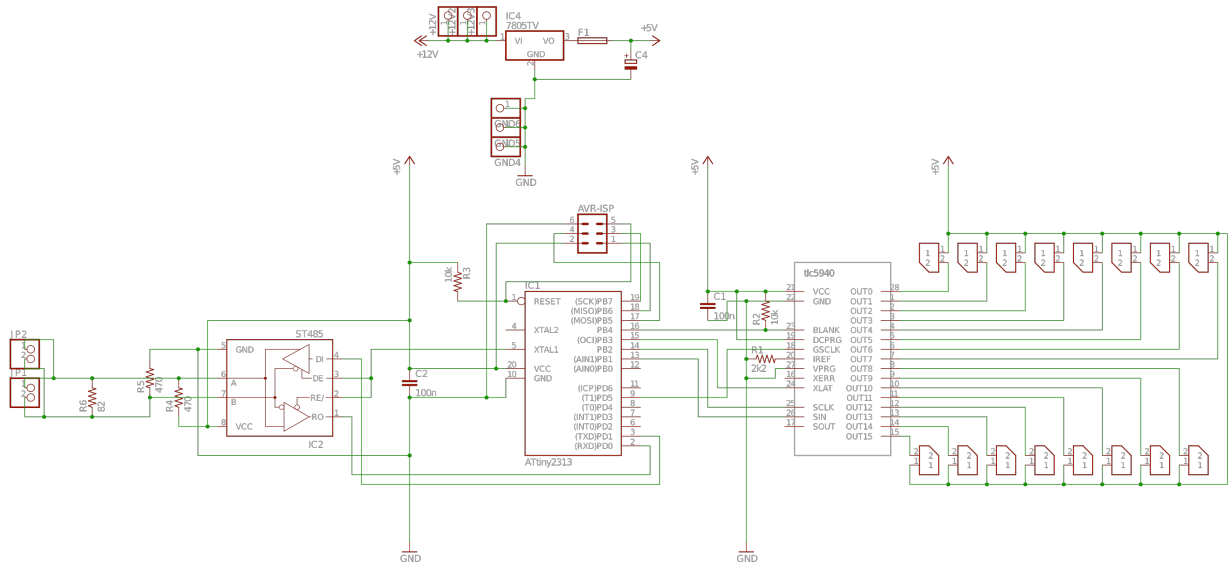


Figure 7: Control electronics block diagram.