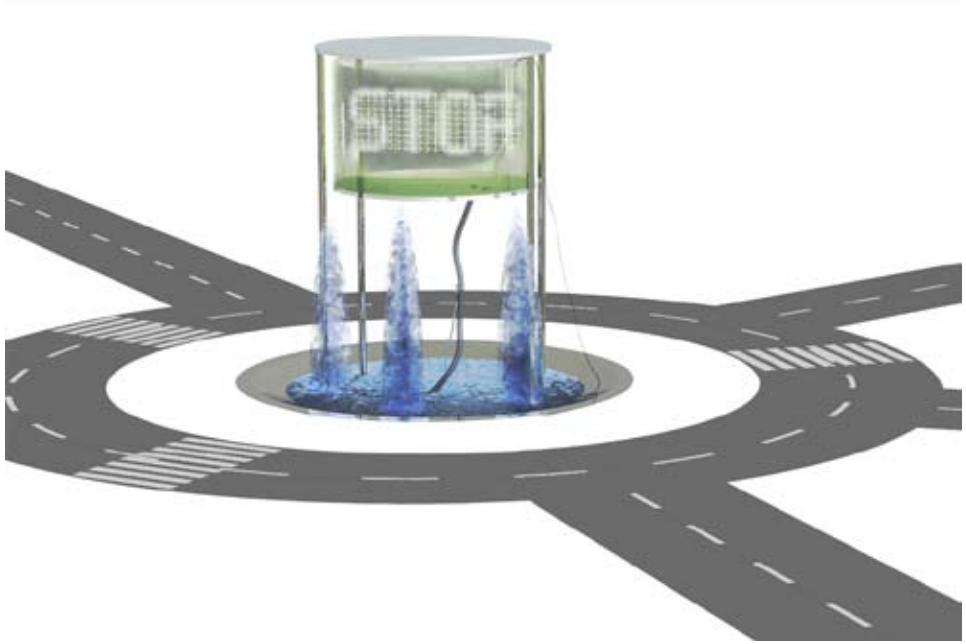
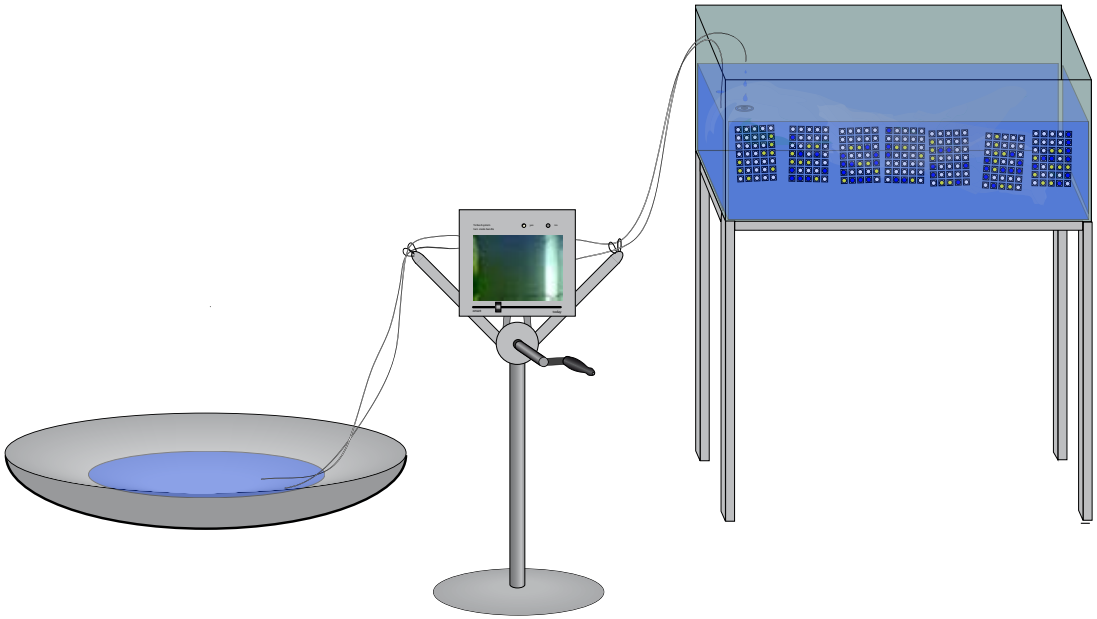


a greenhouse converter



Greenhouse converter
Schema of the installation

The motivation

What can be done to ameliorate the atmosphere in urban space? How can artists help to reduce the negative impact of industrialization on our surroundings?
What should sculptures or green areas look like if plants play their proper role in public gardening as organisms with a specific metabolism– designed by an artist?
What happens, if humans engage with the biological cycles of our ecosystem?
As a media artist I was working with simulations of virtual worlds – self designed ecosystems with virtual creatures and virtual nutrition[1)]. By connecting interfaces to my artificial world it became obvious, that complexity is increasing exponentially and it is becoming increasingly difficult to calibrate a „living" system and keep it alive. Therefore I wished to design hybrid systems – composed of natural and living material but mediated through an electronic control system.
Initially it was my intention to design an installation for traffic islands or for busy public places; the relation between exhausts of air conditioning or exhaust fumes from cars should be obvious just by the position of the art piece.

greenhouse converter (venus V)

interactive installation (aquarium, fountain, user desk,
cybernetic-LED-System),
Laboral, Gijon, Spanien 2010

The idea

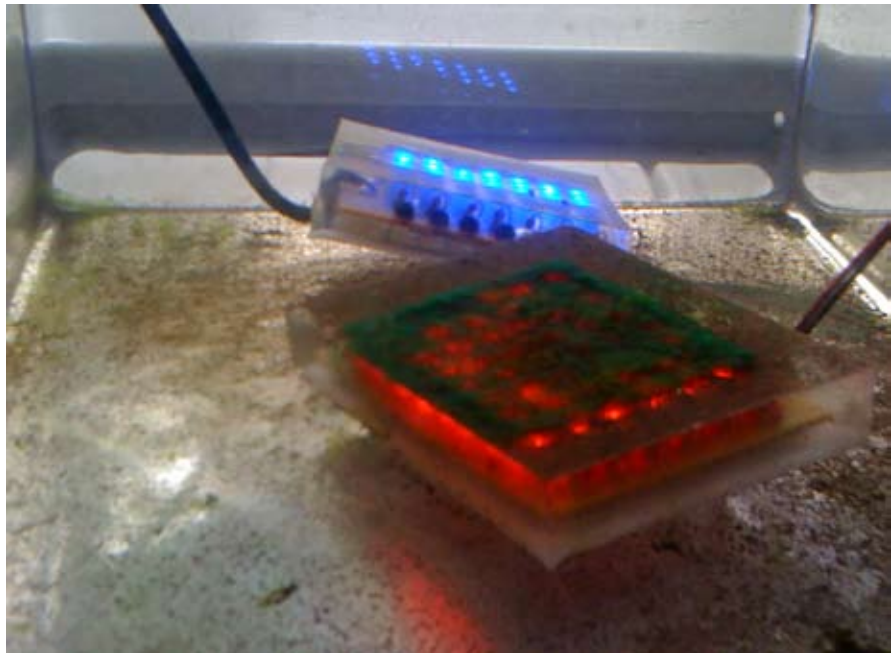
The greenhouse converter is an apparatus for algae, water fleas and people. A cybernetic system, consisting of a light-sensing and light-emitting rgb-LED's [2)], is established in an aquatic ecosystem (here an aquarium) to foster the conversion of carbon dioxide into oxygen.
This setup performs the influence of the exhausts of humans, their power plants and cars on a prototypic aquatic system.

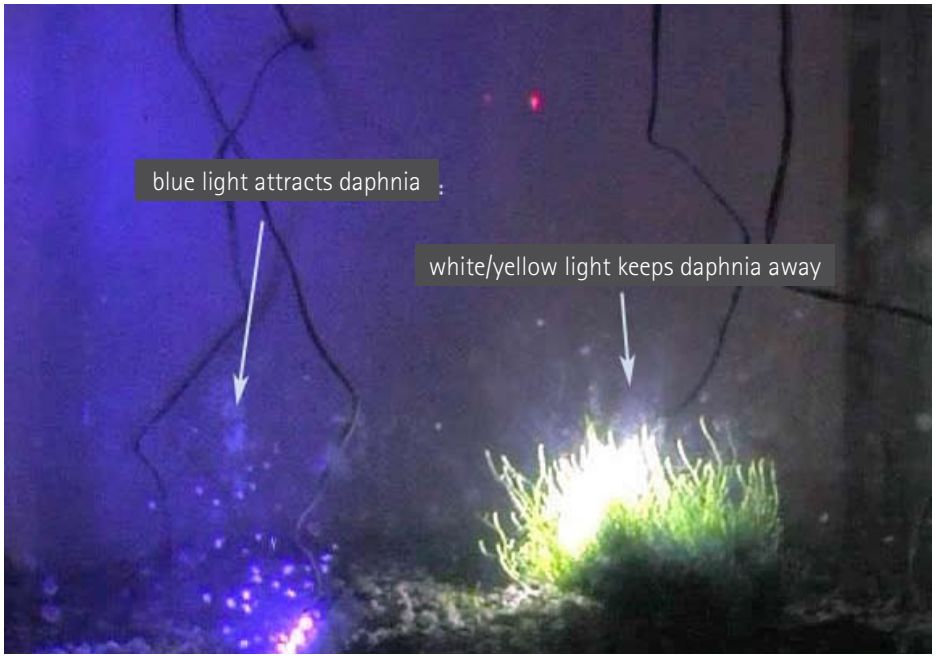
The setup

A water fountain in public area is a familiar way to bind the atmospheric gases in water. My installation could easily be connected to such a fountain and make use of the enriched water for the "gas-exchange" of the aquarium. But it turned out that it was much more realistic to first develop an indoor version of the greenhouse converter, because of the possibility to control the ambient conditions (daylight, temperature etc.) of the system.
The current installation makes use of an indoor fountain (an atomizer) to achieve a high dilution of gas and water. The water, enriched with atmospheric gases, especially carbon dioxide, is pumped from the fountain via an operator terminal into an aquarium. This feeds an algal culture, which, influenced by light, produces biomass and oxygen from the carbon dioxide.
The installation consists of a fountain, a user terminal and an aquarium with algae and water fleas. A system of LED-Displays inside the water constitutes a cybernetic system to balance growth of algae or daphnia.
Algae and Daphnia are part of a natural food chain and depend on each other in a predator-prey relationship.
The greenhouse converter is a demonstration model to emblematize the fragility and interdependency of biological systems.

The cybernetic system and philosophical aspects

The light is observed in the aquarium as the word "beloved", in blue, made p from single LED's, which can be individually controlled. "Beloved" is a reference to the endosymbiosis theories of Lynn Margulis. According to her, cells with a nucleus originate from symbiotic relationships between different types of bacteria. [3)] „Beloved" emphases the interdependence and intrinsic intelligence of ecological systems and the stabilising role of symbiosis and cooperation against competitive darwinistic models.
By transfering living processes into a visible impression of light and color, „greenhouse converter" stresses the role of feedback and selfregulation as an act of cooperation / symbiosis in living systems.
In the greenhouse converter, water fleas react to this word, which appears in blue, they are attracted to it and select the algae adhering to the display as food. The word – set in its blue position – therefore remains visible.
If the water fleas multiply too much and consume all their food supply then the display degenerates, slowly turning yellow, in order to keep the water fleas away and to give the algae space to grow or turning red, in order to promote algal growth.

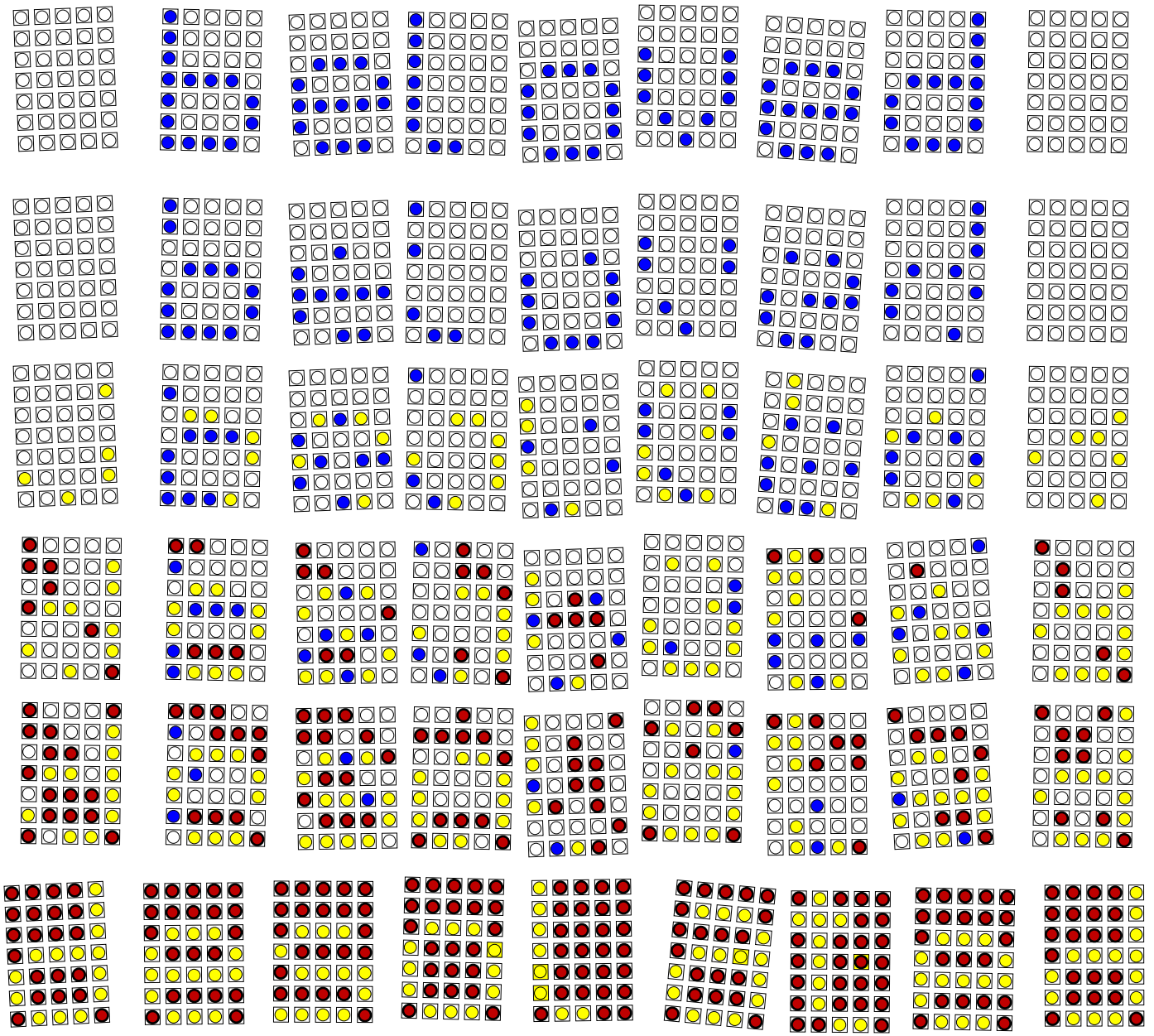


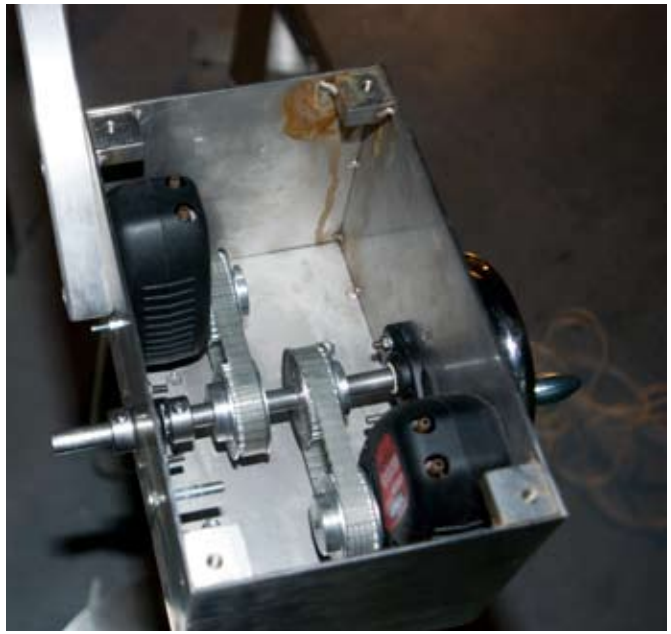


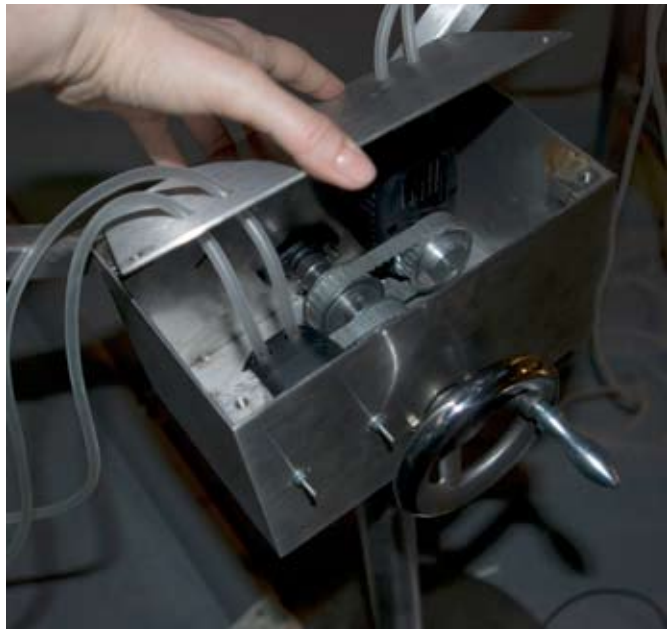
Blue illumination attracts daphnia - yellow illumination makes them flee. Red LED's foster the growing of algues in the water.
The
Die Leuchtschrift besteht aus rgb-LED's. Sie werden als Sensor für Licht funktionnieren als auch als Beleuchtung (in wechselnder Schaltung, ca. jede Minute 1 Messung). LED's können „fühlen", ob der Algenbewuchs hoch ist (sie empfangen wenig Licht). Je nachdem leuchten sie blau, rot oder gelb.
Ist der Algenbewuchs hoch, steuern die LED's gegen, indem sie mit blauem Licht die Wasserflöhe anlocken. Sind keine Algen da (viel Licht), kann mit rotem Licht der Algenbewuchs beschleunigt werden und mit gelb die Wasserflöhe auf Abstand gehalten werden.
Sie stellen eine Art selbstorganisierendes Beleuchtungssystem dar, das der Aufrechterhaltung des Ökosystems dienen soll.

above: experiments with bentic algues
above right: daphnia attracted from blue LED's
right: operating sequence of the display as a reaction to algal growth

Then water from the fountain is also added, so that,
with increased carbon dioxide content, plant growth is stimulated. Over time, the algae grow and grow. They also colonize the word, formed of LEDs, in the water, reducing its legibility. If algal growth is excessive then although a lot of carbon dioxide is broken down, the ecological balance threatens to tip over if the water fleas do not dispose of the algae by vigorously consuming them. To compensate, the light supply is then reduced, since water fleas avoid the yellow daylight and recognize, in the blue light, deep water, which protects them from their enemies.
The status of the display of the word "beloved" serves then as the thermometer of this little ecosystem or rather of its relationship with the greater biosphere, which exists outside it.
If the word can be clearly read, with a lot of points of light displaying as blue, then the system is in a state of balance. Distortions in the ecological system will be manifested in the word becoming increasingly hard to read and cross-fading to the word „desolated", displayed in red letters.



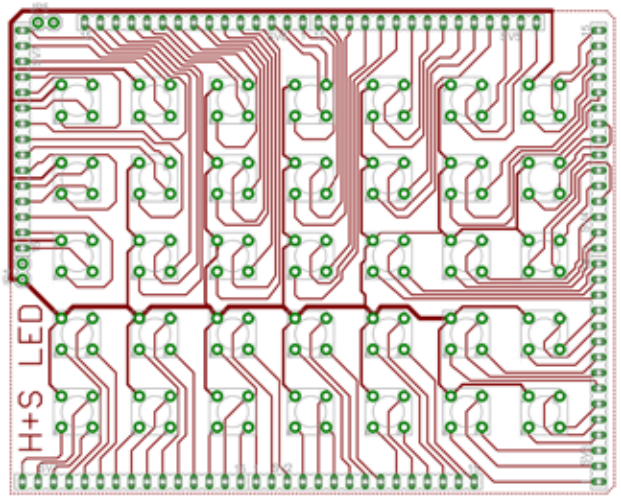


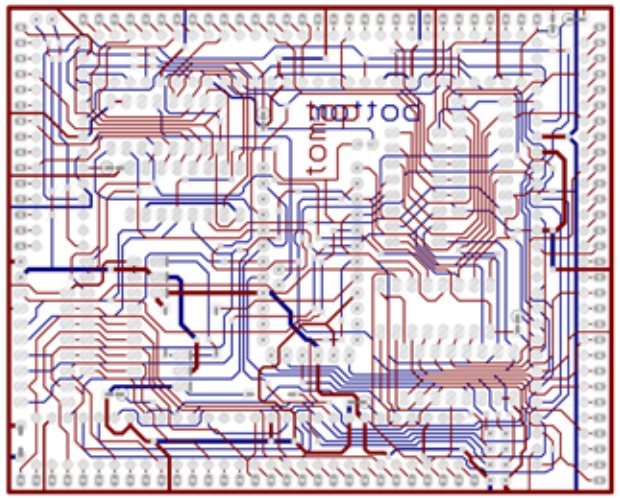


above: inner life oft hte stand with crank and pumps for manual water supply
right: user terminal with fountain,
at Gijon/Laboral, Spain

Visitors are requested to interact with the installation:
To operate the greenhouse converter there is, alongside the aquarium, an operation terminal for a pump, with which passers-by can control the exchange of water and gas using a hand crank. By turning the crank, water is transferred from the fountain to the aquarium and from the aquarium back to the fountain.
The fountain enriches the water with the air of the surroundings. A high CO_2-concentration promotes the growth of algae. A single LED, which is connected to the cybernetic system, indicates to the visitors the oxygen content of the water outside and inside the aquarium. The lever creates the illusion of being in control and is a concession to the desire to be able to use technology to control nature and to keep natural circuits in balance.
An LCD display shows a cctv of the aquarium. It permits to monitor the aquarium over the period of the whole exhibition. Moving the time controll slider, the LCD displays the system's key factors as chronological sequence.

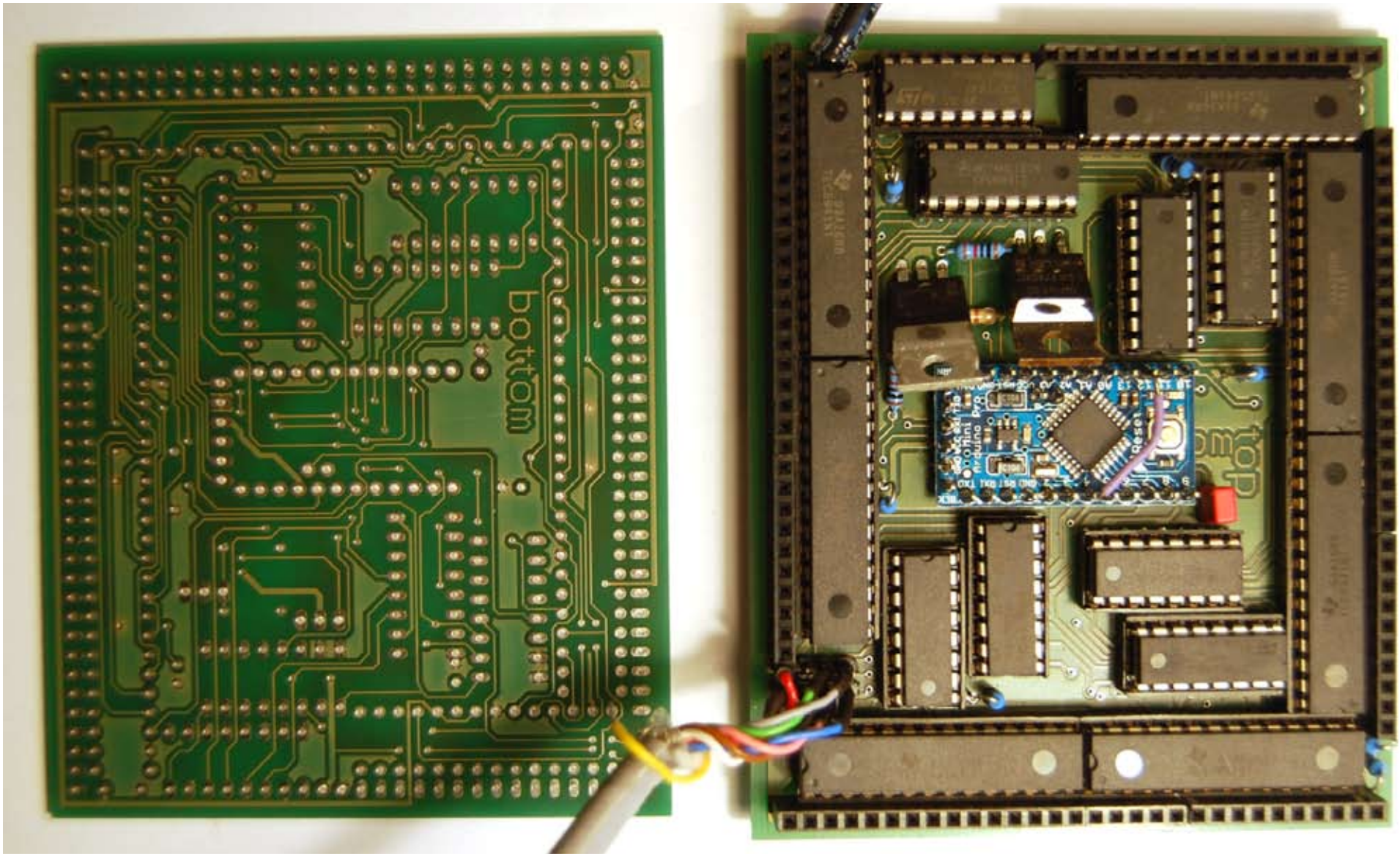

Time flow



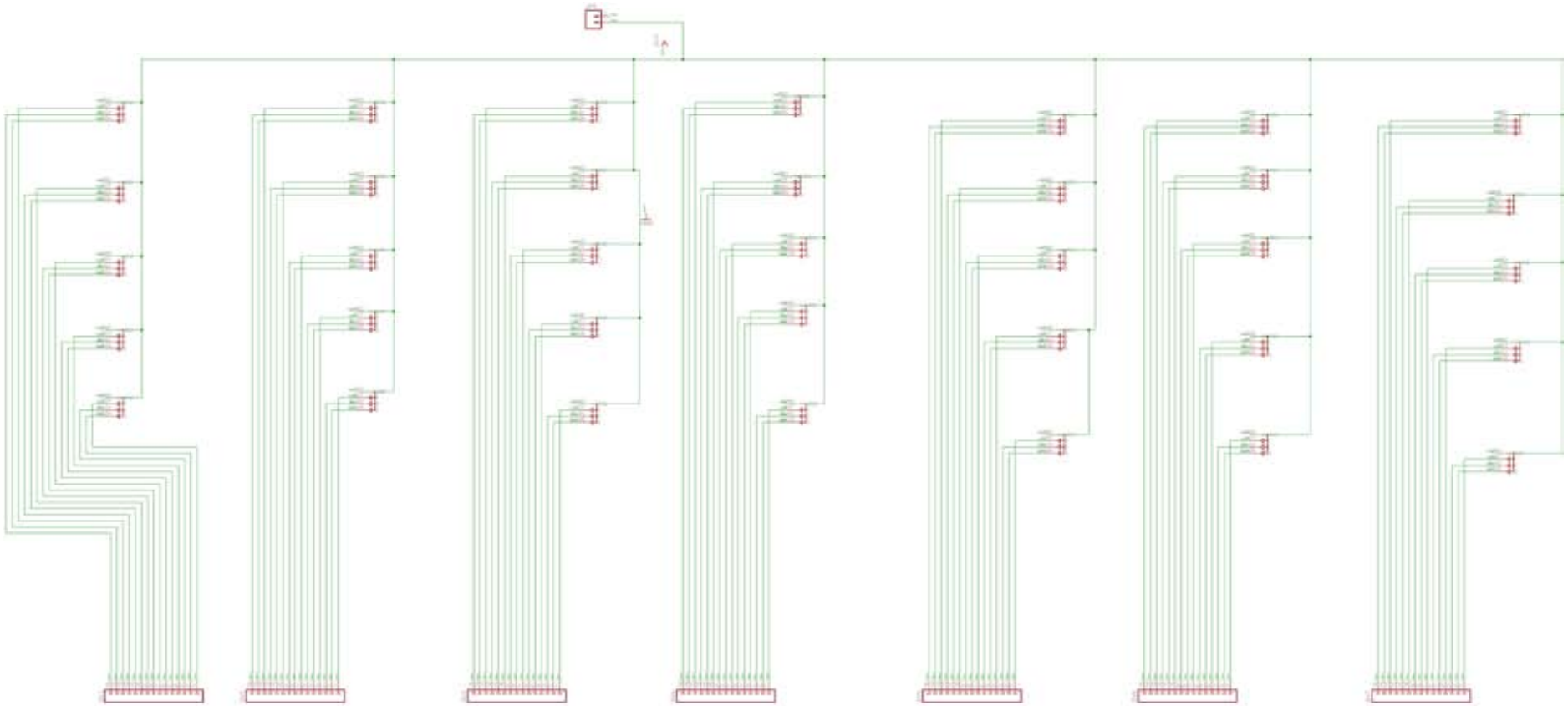


Technical Description

How does this setup work?
The fluorescent letters consists of rgb-LED's. LEDs are commonly used as light emitters but they are fundamentally photodiodes, and as such, are light detectors as well 2). Every Minute, the LED-system switches between light-sensing and light-emitting.
While the diodes are sensing, they detect the concentration of algae by measuring the clearness of the water.
As the algae chosen for the greenhouse converter are benthic (adherent) algae, they colonize the LED's and cover them. This keeps the daylight away from the photodiodes and makes clear measurement results. If there are too many algae, the Display counter-steers and switches slowly to blue light to attract daphnia.
Experiments
Several experiments with different types of algae showed varying suitability. Chlorella vulgaris are very common as nutrition for water fleas (daphnia magna), but they are limbic algae and to small to be indentified as plants. To have organisms, which are visually significant I choose algae of larger scale and adherent to objects in the water. For my longtime tests I had aquaria with Klebsormidium flaccidum, Vaucheria sessilis, Chaetophora spec. and Hydrodictyon reticulatum.
For the installation it was necessary to choose organisms, which are robust and persistent under the condition of exhibitions or longtime-presentation without professional care. Also the water fleas should like the chosen algae. Klebsormidium flaccidum was too sensitive to heat and therefore not persistent, Chaetophora spec. and Vaucheria sessilis seemed to be not very tasty to daphnia. But Hydrodictyon reticulatum came out suitable. It is free-floating or secondarily attached and its meshes are clearly visible in large colonies.
The rapid spread of water-net is believed to be a climate change response [4]. While the massive mats of water-net can prohibit recreational activities and shipping, positive effects on invertebrates are documented.
Daphnia magna is a model organism in aquatic ecology. It is used to monitor the quality of drinking water [5].
The installation is a kind of self-organizing illumination system with the intend to visualize the forces contributing to a balanced ecosystem. The different parts allow to „re-adjust" and maintain the equilibrium of the assembly.



The Board for the interactive LED-Display, 03/2010; Photo and Design: Tom Hanke



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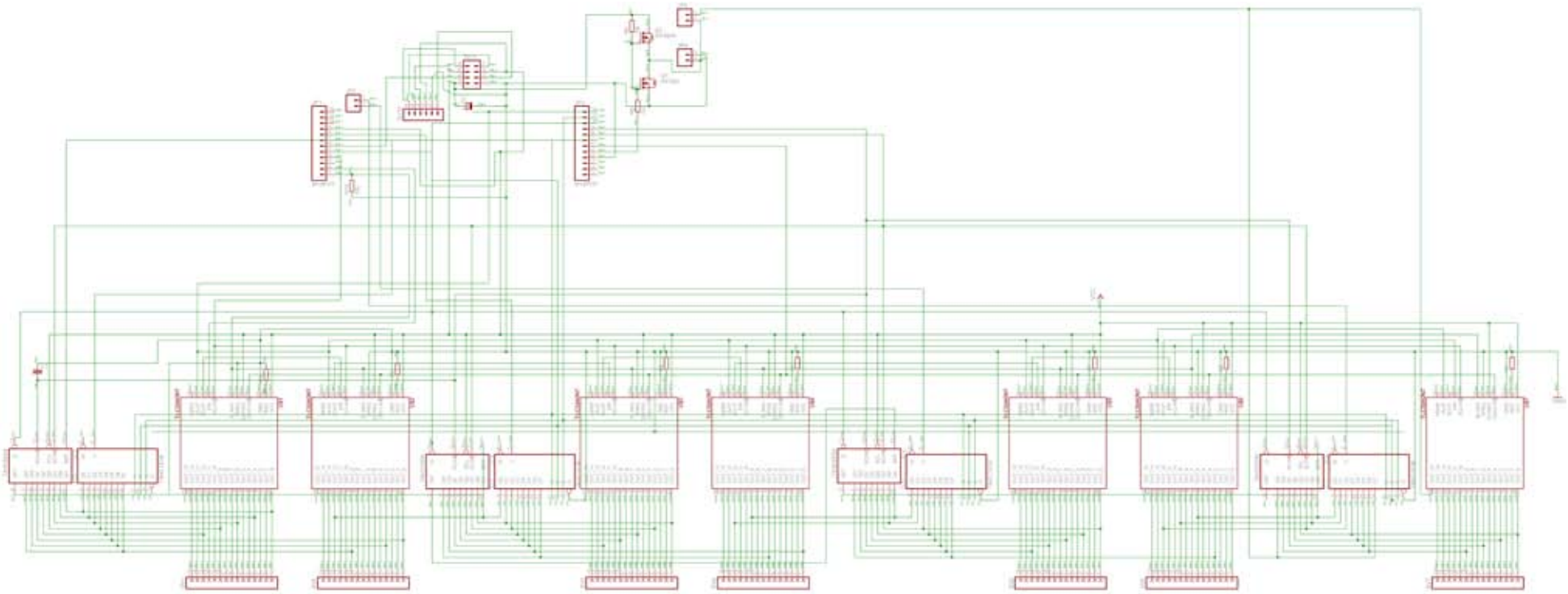
The Design of the Board for the interactive LED-Display (upper part), made by Tom Hanke



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The Design of the Board for the interactive LED-Display (lower part), made by Tom Hanke

right: Hydrodictyon reticulatum
("water net" , algue with phototaxis) and other algues
above: Greenhouse Converter during the
opening at Laboral

Outlook

After having successfully exhibited the installation at LABoral Art and Industrial Creation Centre in Gijon/Spain further indoor exhibitions are foreseen.
What are the next steps to be taken?
I will continue with my experiments to stabilize the viability of the small ecosystem. An important aspect is the water of the arrangement. Tap water is not suitable for algae and daphnia. Rain runoffs are often polluted. Further tests will be undertaken with water filtering systems.
Both organisms chosen for my ecosystem show parthenogenetic and sexual reproduction. It is known, that female Daphnia transmit information not only about food but also on photoperiod to their offspring, and influence the production of resting eggs in the next generation. Also in Hydrodictyon sexual and asexual reproduction can be induced by varying the environmental conditions [6)].
These conditions make the organisms perfect candidates for further experiments on hybrid evolutionary systems.


Sammlung von Algenkulturen
Universität Göttingen
SAG
745-1b
Vaucheria sessilis
Sammlung von Algenkulturen
Universität Göttingen
SAG
199.80
Volvox globator

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