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Absences

Public Art Interventions in Natural Spaces using Autonomous Electronic Devices

Over the past two years, I have developed several autonomous devices meant to act within natural spaces as part of the electronic art intervention project *Absences*. This paper gives an overview of the challenges brought by this project. It gives actual and potential solutions as well as lessons learned through the research-creation process and opens up to the importance of *adaptivity* in future work.

Acting within nature

Electronic and natural systems have inherent differences. It is thus not surprising that introducing artificial autonomous devices in a naturally stabilized ecosystem is not as simple as it looks.

The first challenge of artistic electronic intervention in nature is the mere "survival" of the device. Weather conditions such as extreme temperature, humidity and sunlight can harm components. In the context of using solar cells, such as was the case for all interventions so far, other factors need to be considered. Snow, dust and falling leaves can block the cells, while the shortening of days during Winter and the presence of clouds will reduce energy supplies.

The mere fact that the device is able to maintain its integrity doesn't guarantee that it can do anything aesthetically interesting. The second important challenge is: How can it interact within its environment in a meaningful way? This raises questions about sensors, data analysis and actuators. First, it is important to have sensors that give simple, yet meaningful information about what needs to be measured. For instance, if we attempt to record frogs, using a microphone with the right spectrum range is mandatory.

Fig. 1: Fourth Absence. Autonomous electronic hibernating object. Sofian Audry, Dawson City, Yukon, Canada, 2009. Photo: Picture by the artist.

But having the right tools doesn't guarantee you can do the job: it's all about the way you handle it. My experience with the outdoor has shown that the main difficulty in getting significant data is that natural environments change quickly, in ways that are often hard to measure. As an example, I had a problem with a device that detected sunsets using heat and light sensors. I adjusted the thresholds in December by trials and errors. By February, the system wasn't detecting sunsets anymore because the conditions of enlightment and temperature had changed. Robust methods of processing and analyzing data are thus crucial.

Finally, the choice of actuators (motors, speakers, etc) and their behavior is equally important if one wishes to induce a reaction in natural phenomenons. This aspect is still largely unexplored and will require more observations and adjustments in real-life situations.

Energy management: an example of autonomous behavior

Energy management is a concrete example of acting within nature and a recurring issue in the project. I will here focus on a kind of device that have insufficient access to resources and thus needs to alternate between periods of activity and dormancy, such as is the case for most real-life organisms. How can such a device reach its specific goals in balance with the available energy resources?

A solution to that problem was developed during my stay near the Arctic (Yukon, 2009). I built a device that produced a sound at a specific pace. Between each sound emission, it would switch to a sleep mode, consuming almost zero power. The massive changes in day length in the region throughout the year requires it to adapt its frequency accordingly. The right frequency cannot be computed analytically since it depends on many unkown factors (such as the temperature and the precision of the sensors).

I addressed this issue by relying on a very simple *adaptive algorithm* that updates the frequency of appearance of the action (in this case, emitting the sound) based on the measured batteries power (voltage). If too much power is available, the frequency is slightly increased, rising the energy consumption. If there is not enough, it is reduced in a similar fashion.

Simulations have shown that this allows the device to properly adjust its "biorythm" throughout the year. It also seems robust to daily variations. However, the device was difficult to monitor since I had to leave after its installation and it apparently did not survive Winter (although this might be related to environmental factors such as extreme cold). I thus yet have to produce and monitor a real-life example at this point.

Conclusion

Electronic art intervention in natural sites offers many challenges that range from keeping the devices alive to getting them to interact meaningfully with their surrounding. An important issue is that of power management which can be addressed by adapting the activity of the device to its available resources. More research needs to be carried in order to introduce adaptivity into other perceptual and behavioral components of the devices.

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References

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