numediart

Research Program in Digital Art Technologies - Newsletter 10 Apr 10

Call for Participation

Period 10 - Apr-Jun 10

numediart is a long-term research programme centered on Digital Media Arts, funded by Région Wallonne, Belgium (grant N◦716631). Its main goal is to foster the development of new media technologies through digital performances and installations, in connection with local companies and artists.
It is organized around three major R&D themes (HyFORGE - hypermedia navigation, COMEDIA - body and media, COPI - digital luthery) and is performed as a series of short (3-months) projects, typically 3 or 4 of them in parallel, during which a 1-week "hands on" workshop is held.
numediart is the result of collaboration between Polytech.Mons (Information Technology R&D Pole) and UCL (TELE Lab), with a center of gravity in Mons, the cultural capital of Wallonia. It also benefits from the expertise of the Multitel research center on multimedia and telecommunications. As such, it is the R&D component of Mons 2015, a broader effort towards making Mons the cultural capital of Europe in 2015.

The numediart board now calls for participation to three short projects defined in the following pages, to be held (remotely) from April, 5th to June, 30th 2010. The project will involve a one-week workshop in May in Mons. Results will be publicly presented at the end of the project. If you want to contribute, please send an email to contact@numediart.org mentioning which project you want to join, and what kind of expertise you could bring, before March, 31st. The number of participants is limited to 8 people per project. Participation to the workshop is mandatory. No funding is provided, but no fee is asked for either.

POLYTECH MONS

UCL Université catholique de Louvain

IVISIT: Interactive Video and Sound Installations Tools. Application to the BorderLands project

Idea

This project aims at providing tools to develop interactions with a collection of prerecorded videos and reactive sounds. These tools will be used in the media art project "BorderLands" [1] by the media artist Christian Graupner.

BorderLands by Christian Graupner

In this project the visitor experiences an encounter with a "sleeping" person in a video/audio installation which creates an apparent interaction between the audience and a video character. To make this interaction possible, several video sequences have been shot with a dancer performing a wide range of movements evocative of sleeping postures and developing to expressive figures. In the installation the video will switch from one sequence to the other depending on the visitor's behavior. For the switching to be seamless, branching points between video sequences are necessary, as represented in Fig.1. Branching points have been defined in the choreography before shooting. One of the objectives of this project is to improve the video analysis tools developed at numediart to discover additional unforeseen branching points.

Christian Graupner proposes a 3-D representation, that he calls the *MovieTimeSpace* (*MTS*), which allows both to see all the branching points as crossings and to divide the space in concentric zones corresponding to different body-related **states** (Fig.2). The system evolves between these states, depending both on the visitors' activity and on a self-generating processes. Beyond the outer sphere, video sequences are connected through creative morphing. Those movies are combined with a dynamic graphic layer, called the *NET*, reacting to the shape and movements of the dancer and to external input (Fig.3). The envisioned setup for this installation would be a pit at the bottom of which the images are displayed. The visitors bend over the sensitive balustrade to watch the "sleeper" (Fig.4).

The visitors' behavior needs to be monitored in various ways and part of this research will consist of experimenting with different technologies to define a stable setup, sensitive enough to involve and immerse the visitor into the flow of the installation: small range sensors on the edge of the pit (most likely a combination of pressure and Theremin sensors) to detect the position, distance and pressure of the hands of the visitors, and long range sensors (laser scanner or video camera) to detect wider movements of the visitors. Analysis of the sensor's data will first create a direct sound feedback to the visitor, helping him to get conscious of his short-term actions, and to enhance his perception of *MTS* navigation. Second, it will induce changes in the state of the system and modify navigation strategies within the *MTS*, generating longer-term changes. Third, it will influence *NET* transformations.

In the installation the sound will also react to the content of video sequence being played. This requires annotating the video sequences with features extracted at a preliminary analysis stage. Manual annotations and editing of the automatic annotations will also be taken into consideration. These annotations will be used during the playback of the video sequences in order to reflect the movements of the sleeper/dancer within the sound and to give additional cues for the computation of the deformation of the background.

Motivations

This project has been divided into several axes of research, that intermingle to achieve the goals of the Borderlands project: video analysis and annotation, state-based visitor behavior analysis, *MTS* navigation strategies and interactive sound.

Video analysis and annotation

Video analysis will be used to automatically detect possible branching points between video sequences, build-

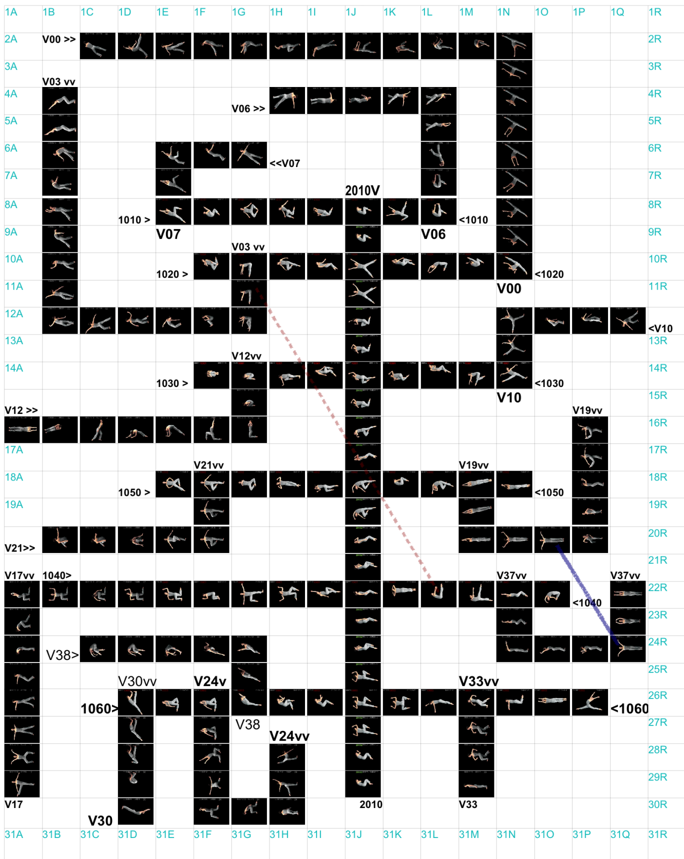

Figure 1: Schematic of interleaved video sequences, with branching points at each crossing. Additional lines are needed to show them all, as a 2-D space does not allow to display them all as crossings.

Figure 2: 3D Representation of the *Movie Time Space*. The concentric spherical zones represent different states of the system (i.e. asleep in the center, gradually awakening towards more choreographic images on the outside). Graphics by Ulla Kaes.

ing upon knowledge acquired during previous numediart projects [3, 5]. Matching points between frames of video sequences will not only involve shape analysis, but also dynamic features such as the directionality and amplitude of the motion [2, 6, 8] . This analysis could be based on the notion of optical flow, and serve as a basis for the annotation [4].

Visitor behavior analysis

To analyze the interactions with the visitor, several sensors could be used. The first task will thus be to analyze and compare pros and cons of different sensors (e.g., pressure, Theremin, camera, laser scanner) in the setup of this installation. Then a state model of the system will need to be defined, as well as a set of rules to alter the states. These rules will also be used to reflect the visitor's movements in the sound.

Navigation within the video sequences

The choice of the next bifurcation will have to be adapted according to the visitor's behavior. This will also depend on the state of the system and on the paths already traveled. Additionally, the system should allow to define moments of "scrubbing", time distortions and looping according to video annotations and to visitor movements.

Video rendering and *NET* transformation

The real-time rendering of the video will be done with the *AniMiro* software application, developed by André Bernhardt at *reactiveshop GmbH*, in Karlsruhe, Germany. Each frame of the video sequences will be encoded in jpeg so as to avoid key frames in order to be able to play them freely forwards or backwards. Our navigation software will be able to control the frame to be displayed in real time with OSC messages. In order to produce very high quality transitions between sequences, the morphs will be computed off-line for each possible transition. *AniMiro* runs on customized Linux systems using OpenGL for rendering and supports multi-camera and multi-screen projections. Its ability to capture and interpret data from sensors and its palette of real-time effects allow it to generate the *NET* deformations for BorderLands directly from the content of the video frames. Those deformations can also be controlled, through OSC, with the data coming from the stereoscopic camera tools we developed at numediart on the *Fire Experiences* project, the Theremin sensors developed at ARTeM, the pressure sensors and the annotations linked with the video sequences.

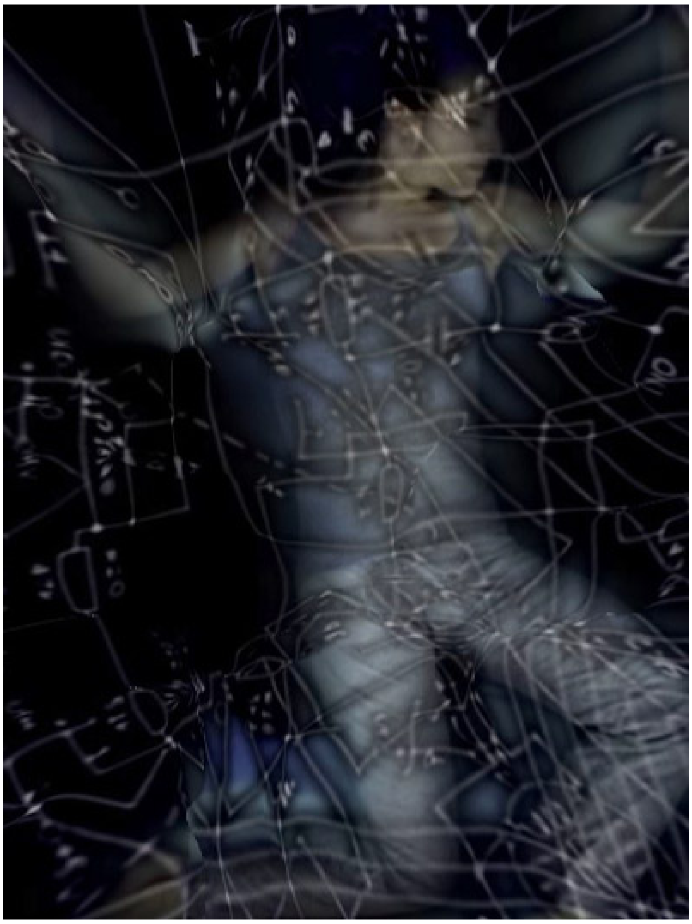

Figure 3: Prospective Image of the video combined with background reminiscent of the connections between videos.

Interactive sound

Several strategies will be used concurrently: sound selection and triggering, transformation and generation. They will allow to navigate between pre-composed music sequences and to provide real-time morphing strategies [7]. We feel that the definition of physical models for sound control, altered by the movements of the visitors, is well-suited to this application. We are planning to use Box2D, an open source C++ engine for simulating rigid bodies in 2D. Box2D is developed by Erin Cattoan from the Massachusetts Institute of Technology. It has interesting features like continuous collision detection and there are ports for other popular programming environments like Max/MSP or Processing.

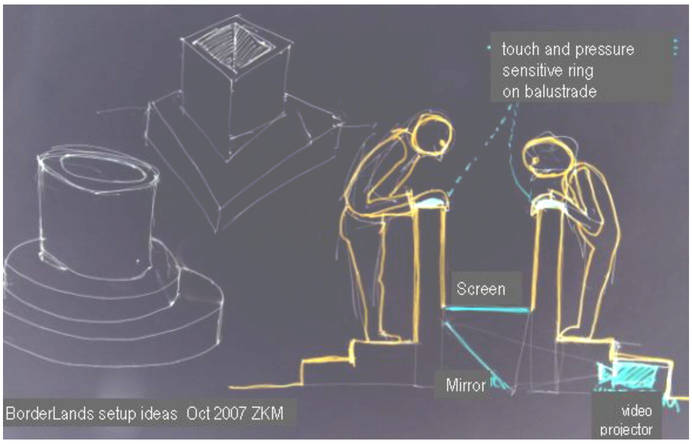

Figure 4: Schematic of the installation setup. The videos are projected on a screen that the spectators watch by bending over a balustrade equipped with sensors.

Agenda

- 01/04/2010: Project start.
- Week 1: Kickoff and coordination.
- Week 2: Video Analysis, sensors and state model.
- Week 3-4: Workshop split between Zentrum fÿr Kunst und Medientechnologie, Karlsruhe and Umons.
- Week 5-7: Video Analysis, Navigation software and sensors interaction.
- Week 8-9: Workshop at Zentrum fÿr Kunst und Medientechnologie, Karlsruhe, with a focus on sound interaction.
- Week 10-11: Navigation software, installation prototype
- Week 12: Reporting and packaging deliverable.
- 31/06/2010: Project end and public presentation.

Team

This project is coordinated by Todor Todoroff (FPMs/TCTS) and Xavier Siebert (FPMs/MathRO) from April-June 2010. Radhwan Ben Madhkour (FPMs/TCTS) will work on the video analysis and on the stereoscopic camera software. It will be done in collaboration with Christian Graupner, the artist who conceptualized the Borderlands project. He is also the co-founder of Humatic, a Berlin based independent artist group and production company which has developed software applications for dynamicly controllable media playback. It will benefit from interactions with the ZKM Zentrum für Kunst und Medientechnologie, Karlsruhe, Germany. Indeed, the preliminary visual research has received support from its visual department, and its music department has invited Todor Todoroff for developing the music of BorderLands.

Deliverables

1. software for detecting intersections between videos
2. state-based model of behaviour of the visitor with sensors and camera data input
3. BorderLands installation prototype

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Idea

This project presents a novel approach that combines physically based synthesis methods and handling of pre-recordings into an adequate multimodal user interface for sound composition and design, so as to create rich soundscapes, texture sounds, and various musical compositions.

The goal of AudioGarden is to propose a usable tool for analysis, synthesis of sounds and creation of coherent soundtracks that we call *composite*.

Motivations

Soundtrack composers, sound designers and electroacoustic music composers aim at creating auditory experiences. Regarding computerized systems enabling these practises, while the use of recorded sounds is easy to implement, the number of samples in a database is often limited due to memory constraints, and variety in the sound rendering is difficult to create. On the other hand, physically-based sound models have been developed to synthesize sounds even from virtual objects. However, the resulting sounds sometimes lack realism and expressivity. Additionally, these "end-user" specialists, not necessarily well versed into complex algorithms for audio analysis and synthesis, fatally need to master environments for script-based programming (for ex: Octave, Matlab) or modular visual programming (for ex: PureData, Max/MSP) that require knowledge of dedicated syntaxes and accurate understanding of the underlying processes. Past works attempting to gather both approaches essentially mix methods [2, 1]; and most proposed user interfaces are WIMP-based.

We propose to embed sound analysis/synthesis methods within the MediaCycle framework, particularly the AudioCycle range of applications. The AudioGarden prototype would provide an adequate categorization of example-based sounds and physics-based sounds, along with appropriate methods to ensure the coherence in the composite synthesized soundtracks. We will also focus on tools for building sound events by arranging sounds in time, into a user-friendly interface.

Hypermedia navigation and search by similarity with MediaCycle

AudioCycle, a prototype application for browsing through music loop libraries, has been developed within numediart since late 2008. Audio extracts are visualized and organized on a graphical view according to their similarity currently in terms of musical properties, such as timbre, harmony, and rhythm. By navigating in this visual representation, the user is able to listen to individual audio extracts, searching for those of interest.

This hypermedia navigation approach has been since then extended to the MediaCycle framework, supporting other media such as image and video and allowing server/client interoperation. Though the most recent trimestrial numediart project up to date, MultiMediaCycle, in late 2009, support of more gestural controllers through a refined OSC namespace has been added, conveniently using PureData to prototype gestural user interfaces with HID and force-feedback devices.

To be usable for sound design practises, the MediaCycle framework currently lacks a timeline to sequence sounds, sound analysis and synthesis methods towards sound events.

Synthesis approaches for sound design

In order to create soundtracks for movies or video games, Foley artists mainly rely on prerecorded sound material, or record it themselves. The sound variety depends mostly on the size and richness of the audio database. For quite particular sounds textures, the choice is often reduced to a few selections. On the other hand, sound composers are more familiar to synthesis techniques, and appreciate the ability of physics models to synthesize sounds even from virtual shapes. However, these models are difficult to tune and lack of expressivity.

We propose to address physically-based synthesis through modal analysis, that is by modeling a vibrating object by a bank of damped harmonic oscillators which are excited by external stimuli. Modal decomposition allows efficient runtime and control of the vibrational response. The modal approach of [5], robust and multi-scale, allows to manipulate a large variety of sounding objects. It uses CAD models as input and calculate the modal parameters with the SOFA Framework (available under the LGPL license), see Figure 5.

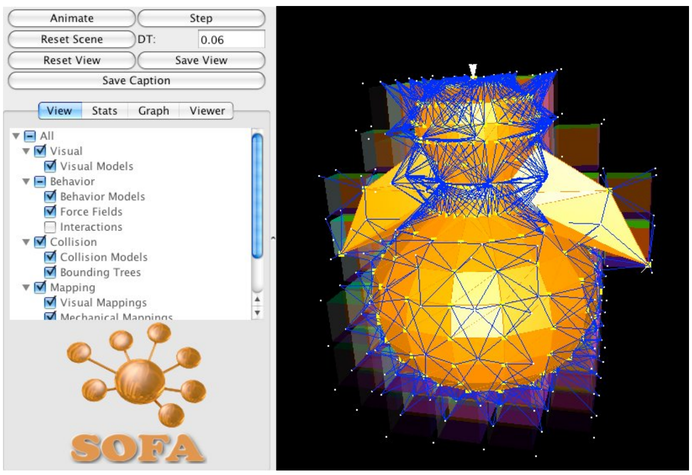

Figure 5: *The modal approach of [5] uses CAD models as input and calculate the modal parameters with the SOFA Framework.*

By modal synthesis, we model the impulse response of a resonator. To be classified on the same basis, physically-based sounds and sample-based sounds have to be comparable. For this reason, we propose to extract audio grains from the available database of prerecordings based on the method developed in [4]. The method allows automatic extraction and is adapted to the type of sound recordings. We assume that audio grains correspond to, for instance, to single notes in an excerpt of piano piece, i.e. small waveforms ranging from hundredths of, to a few seconds.

The classification of sounds using AudioCycle would allow to draw similarities between physically- and sample-based sounds. Starting from its proximity to a sample-based sound, a physically-based sound could be used for temporal arrangement based on the rhythmic pattern of the original recording from which the sample-based sound is extracted. One approach could be to deduce the temporal arrangement by calculating the cross-correlation between the physically-based sound and the original recording. Thus, coherence in the created sound event would be guaranteed. Other techniques can be investigated so as to ensure the variety of the resulting compositions.

Deliverables

1. A collection of CAD models and sound recordings.
2. MediaCycle plugins for sound synthesis and analysis:
   - physically-based modal analysis/synthesis approach [5] applied on CAD models using the SOFA framework;
   - signal-based grains extraction and modeling of the grain sequencing applied on audio recordings databases based on [4];
   - additional feature extraction algorithms to describe physically- and sample-based sounds [3] and to compare both.
3. MediaCycle UI features:
   - support of the Alias Wavefront *.obj format with interactive thumbnailing;
   - media sequencer/timeline view or drag-and-drop of media files from/to other applications;
4. A new MediaCycle prototype application with a dedicated visual interface with sound/3D models browsers gestural controllers that allows to:
   (a) select CAD models with which we want to synthesize modal sounds;
   (b) select audio grains that are similar to the physical sounds in respect to user-defined features;
   (c) easily construct a sound event that gather physically-based sounds and sample-based sounds/rhythmic, then saved into the database;
   (d) log the corresponding parametrization of the resynthesized sound events for hybridization;
   (e) recommend characteristic rhythmic patterns.
5. Preliminary qualitative testing of the prototype.

Updates are provided on http://blog.audiogarden.org

Team

- Christian Frisson (UCL-TELE) will focus on the usability of the visual and gestural user interface.
- Cécile Picard, who obtained a grant from the Sonic Interaction Design (SID) COST Action as a Short-Term Scientific Mission (STSM) so as to fund her visits to the numediart research labs, will cover the physical- and sample-based analysis/synthesis techniques.
- Damien Tardieu (UMons/TCTS) will improve and adapt feature extraction and clustering algorithms.

Agenda

- 29/03/2010: Project start.
- Week 1 (09/03-2/04): 1st visit from Cécile Picard to the numediart labs
  - Integration of the MediaCycle plugins for sound analysis/synthesis
  - Brainstorming sessions towards paper mockups and specifications of the desired interface
- Week 2-7: Implementation of MediaCycle features and the AudioGarden prototype.
- Week 8 (17/05-21/05): 2nd visit from Cécile Picard to the numediart labs: Qualitative usability tests for the validation of the prototype.
- Week 9-13: Improvement of the prototype based on user recommendations.
- End of June 2010: Project end and public presentation.

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Developing Social Controllers

Idea

The idea of this project is to create a development environment for the production of small, so-cheap-as-to-be-given-away, electronic devices, or "controllers", which promote social interaction. The development environment will use an already developed platform (assumed to be an iPhone for the rest of this project description) to simulate the limited capabilities of the production devices. At the first stage, at least one set of proof-of-concept devices will be produced. The examples given here focus on audio and music, but could change depending on the artists and/or engineers involved.

These devices would have control components (switches, potentiometers, light sensors, etc) and feedback components (speakers, LEDs, etc). The devices would be interesting by themselves for generating sound or display, however, the devices will also have communication components (blue tooth transceivers, infrared transducers, microphones, etc) which allow the devices to interact with one another. The devices will change their behavior significantly when in groups to encourage social interaction of the people holding the devices.

The first stage of this project would be to create an initial interaction-prototyping application using two iPhones. The reason for this is the immediate access to the diverse and numerous sensors available. We also already have the Software Development Kit (SDK) for the Apple iPhone.

Simple Example Scenario

The device contains one low frequency oscillator (LFO) and one audio frequency oscillator with a speaker. The LFO controls both the strength of an LED and the frequency of the audio oscillator. A light sensor on the device controls the amplitude of the audio oscillator. By bringing one device's LED near the light sensor of the another device, the amplitude of the audio oscillator of the second device would be controlled by the LFO of the first device. By creating an LED to light sensor loop between the two devices, amplitude beats would emerge with corresponding changes in the frequency modulation of the audio oscillators. (Other possibilities are derivable from the Sound Gizmo by Fundimensions [4], the Sound FX Machine by Remco [3], and the Thingamagoop by Bleep Labs [5].)

Complex Example Scenario

The device contains a small microprocessor which has short samples of rhythms in it. A switch controls which rhythm is being played. The device also contains a blue tooth transceiver. When two devices come near each other they discover the tempo, downbeat, and key of each other. They then would then synchronize. Perhaps one of the devices generates an entirely new instrument sound which is only available when two devices are interacting.

Motivations

This project has several motivations:

- technology as a social connecting force,
- exploration of collaborative interaction,
- exploration of the iPhone/iPod Touch sensor capabilities,
- exploration of limited sensors as controllers,
- efficient electronics and device design, and
- utilization of microelectronics materials and expertise.

Background

There are several projects in this realm which, when taken as a group, demonstrate the feasibility of this project:

- Tristan Perich has created cheap 1-bit music devices which lack the communication components, but have other similarities to what is desired from the new devices [2].
- Gil Weinberg has created group musical experiences using similar devices, but his are not intended to be cheap enough to give away [6].
- M.C. Feldmeier has created hand-out motion sensors for use in group dance gatherings [1].
- BleepLabs has created a product called the Thingamagoop which is more complicated but is similar in concept.

Reusing past projects

Ricardo Bose (see Team section) works currently with microcontroller projects in the Electronics Department at UMONS and already has been working towards integrating current music programming software into these projects.

J. Anderson Mills III worked on a music programming interface using Java in numediart session 8. Though this technology cannot be directly applied, the concepts and expertise will be useful, especially in the interaction prototyping phase.

Technological challenges

One of the main issues with this is the mapping of sensor technology to useful, creative, and engaging parameters which promote social interaction. The interaction prototyping phase will be executed using the iPhone. These devices have multiple sensors already integrated into them and the Apple iPhone SDK will allow us to create prototypes of the interactions between the sensors. Another technological challenge will be implementing the control of the components using the microcontrollers of choice.

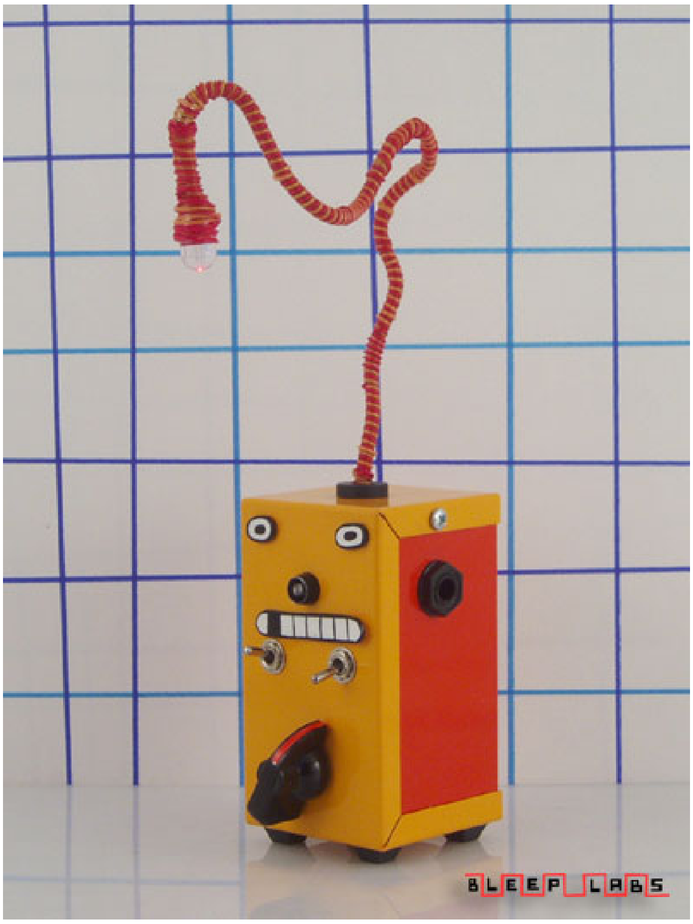

Figure 6:

Team

This 3/6-month project is coordinated by J. Anderson Mills III from FPMs/TCTS from March-May/September 2010.

Possible numediart participants

- J. Anderson Mills III for project leadership, microcontrollers, electronics, and musical and sensor interactions
- Loïc Reboursière for musical and sensor interactions
- Ricardo Bose for microcontrollers

Possible Internships

- numediart has already been approached for two one-month internships concerning this project.

Agenda

The first phase of this project is a complete three month numediart project. This phase would reach the stage of generating prototype devices for the simple example scenario listed in the Idea section.

- 01/04/2010: Project start.
- Week 1: Kickoff and coordination.
- Week 2-7: development of the iPhone prototyping application
- Week 8: Workshop week - multiperson prototyping of device interaction
- Week 9-11: development of the physical prototype devices
- Week 12: Reporting and packaging deliverables.
- 31/05/2010: Project end and public presentation.

If an evaluation of the first phase warrants continuation of this project, a second phase of this project would attain the generation of the prototype devices at the level of the complex example scenario in the Idea section.

- 01/07/2010: Project start.
- Week 1: Kickoff and coordination.
- Week 2-7: production of phase one devices, development of phase two devices
- Week 8: Workshop week - phase two device interaction testing
- Week 9-11: production of phase two devices
- Week 12: Reporting and packaging deliverables.
- 31/09/2010: Project end and public presentation.

Deliverables

1. iPhone application - prototyping social interactions facilitated by sensor-enabled devices
2. prototyped sensor-enabled, social interaction devices with feedback/receiver components
3. prototyped sensor-enabled, social interaction devices with wireless communication components

References

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numediart **Research Program**

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