

Solarcoustics: CONNECT

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ABSTRACT

CONNECT is a solar-powered personal electronic device. This paper describes the design, concept, and technology used to create the device. By using a photovoltaic cell, CONNECT harvests light energy to generate audio oscillations. CONNECT creates a unique personal sonic space with potential uses for performance, relaxation, and education.

General Terms

Documentation, Performance, Design, Experimentation.

Keywords

new interface for musical expression, solar powered, mobile music

1. INTRODUCTION

Solarcoustics:CONNECT(see figure 1) is a new platform of personal electronic device. CONNECT maps photovoltaic energy to audio oscillations using photovoltaic cells and basic audio circuitry. CONNNECT is responsive to light either from the sun, or from artificial light sources. By utilizing photovoltaic energy CONNECT needs no batteries to operate. It harvests and stores light energy from its environment. CONNECT gives the user a new awareness of their surroundings and allows them to “jam” with their environment.

2. BACKGROUND

Photovoltaic technology has been used in consumer electronics for many years. Most commonly photovoltaic and solar technology has been used in calculators, toys, watches, etc. I originally began to use photovoltaic cells as part of a project for the Sustainable Technology class in the Interactive Telecommunications Program at New York University. My intent was to create a solar powered toy that would create sounds based on environmental conditions. I chose photovoltaic panels, because I wanted a passive energy harvesting activity. Ideally the device would simply exist in an environment and function on its own without any user input. During the prototyping phase I realized that my simple circuitry could be contained in a small, portable package. As well, by implementing a simple headphone jack I could create the ability to have a personal user experience.



Figure 1 Solarcoustics:CONNECT.

During this initial prototyping phase I needed to find a way to get a lot from a little. I began working with an epoxy coated polycrystalline solar cell (see figure 3), which operated at 6.7 volts with a current rating of 15 milliamps. These specifications are in ideal direct sunlight environments. In ambient light I was getting a measurement of .16 volts. I realized quickly that my power would be very limited and I needed a means to store and to convert this energy into some form of audio. I decided to use a simple circuit, which would charge a 5 Volt 1 farad capacitor then discharge it into a low power 555 timer chip. The low power timer chip when operated in astable mode functions as an oscillator. I began to prototype with these simple elements; a solar panel, a large capacitor, and a 555 timer chip. I connected the output of the timer chip to a standard 1/8th inch headphone jack so that I could analyze the signals on my laptop using Max/MSP.



Figure 2 CONNECT, connected to headphones.

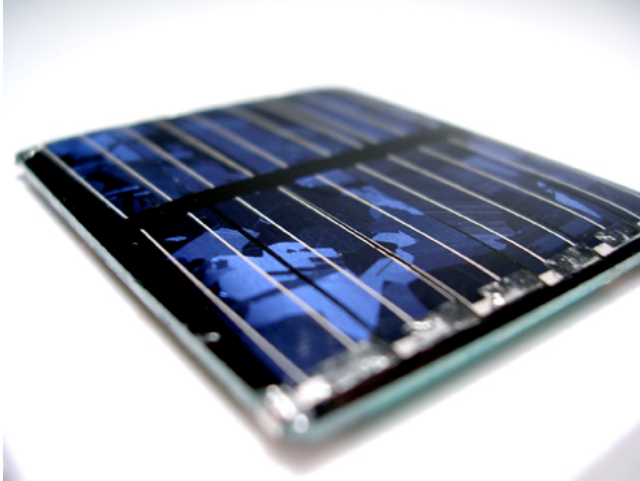


Figure 3 Epoxy coated polycrystalline solar cell

The 1 farad capacitor allows for the device to charge in sunlight or under a desk lamp, then discharge over a period of time. This could allow for an extension of the experience as the user exits a lit environment and enters a subway train or elevator.

My final circuit design was based on a voltage-controlled oscillator from a Radio Shack Engineers Mini Notebook. This circuit was ideal for my application. The circuit created oscillations based on an input control voltage and maintained a simple design. As well, the low power 555 timer chip allowed operation from .9 volts to 9 volts. It was at this point that I realized that I could contain all of these parts in a small portable device that could be held by the user, or worn on the body.

3. DESIGN CONSIDERATIONS

During the initial circuit prototype phase I began to consider what form the device would take. I wanted to create a simple device that felt comfortable in the hand. I settled on fairly standard plastic boxes, which come in several different colors. I started out by using clear and white boxes, which were sanded down to give a smooth finish and rounded corners. The circuit board was designed so that it could be “friction fit” into the plastic housing (see figure 4.). The circuit board also contained the headphone jack so that the entire operational element of the device could be moved to a separate housing if needed.

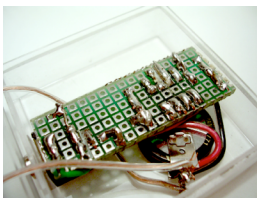


Figure 4 Circuit board in housing.

4. REALWORLD PERFORMANCE

CONNECT performs very well in direct sunlight environments, the user can move the device around to create variations in the oscillations. Indoor settings provide to be a bit more challenging, but by placing the device under a halogen lamp it acts quite

responsive and allows the capacitor to charge. I found that I could charge the device for a few minutes, then operate in darkness as the device discharges.

The user can create changes in the oscillations by altering the position of the solar panel to the sun, or by using their hands to shield the solar panel from the sun (figure 5.). As the amount of light reaching the panel changes, the corresponding oscillation changes in real time. The amount of light is proportional to voltage, as more voltage is applied to the circuit the oscillation reduces in frequency. This process of manipulating the relationship of the panel to the light creates a gestural mode of sonic exploration. Rhythm and change in pitch can be established by performing repetitive movements with CONNECT in and out of light and shadow.



Figure 5 User controlling sound output of CONNECT.

5. RELATED PROJECTS

Sonification of the sun and solar energy has been of interest to artists and scientists for many years. In particular the study of wave oscillations in the sun, otherwise known as helioseismology are used to study its inner structure[1]. In the Solar Center at Stanford University, researchers have created sonifications of the wave oscillations in the sun. These studies help to provide an understanding of the interior structure of the sun.

Danish artist Thorbjørn Lausten[2] in collaboration with the Stanford Solar Center, visualized the oscillations of the sun from using data acquired from the SOHO spacecraft. The data of the solar oscillations were mapped to control the motion of lights and filters in an installation space. The images created by the data would change the shape and color of the lights in relation to the oscillations of the solar surface.

Toshio Iwai-Sound Lens 2001[3] PS-1 used light of various frequencies to create a rich interactive sound environment by combining sound, light and movement. The Sound Lens is a device that maps the various frequencies of light to sound output. Users would carry the device in their hand and listen to the sounds it through headphones. The work relies not only on the device itself, but on the specific lighting that the designer installed in the space.

Another interesting project which relates directly to CONNECT is the Acoustic Survival Kit by Felix Hahn, Miki Yui, Ralf Schreiber[4]. The Acoustic Survival Kit (or ask02 more specifically) invited the user to build their own custom circuits from special fabrics with embedded electronics. The ask02 is solar powered and uses simple audio circuitry to produce audio in a response to notions of public and private space.

6. CONCLUSION AND FUTURE ITERATIONS

CONNECT represents a successful attempt to create a solar powered gestural musical device. Future configurations will include the use of variable capacitance within the system to allow for a more dynamic sonic experience.

As well, by connecting two devices together using standard headphone splitters multiple users can mix the audio of their devices together. In this mode two or more users can perform and experience the sounds together. During a public showing of the project users were able to experiment with connecting multiple boxes together. The results were very interesting. Users experimented with creating dissonant and harmonious tones by varying the amount of light falling on each of their respective solar panels. By connecting the devices together users can

perform collaborative improvisational works. I am very interested in pursuing this line of work further. My future goals for Solarcoustics:CONNECT is to design low cost, low power, interactive audio devices that allow for people to experience new applications for sustainable technologies.

7. REFERENCES

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- [3] Sound Lens
<http://www2.gol.com/users/iwai/PS1data/SOUND-LENS.html>
- [4] Acoustic Survival Kit-<http://www.khm.de/ask/>