




Inclusive Eclipse: a sensorial experiencing along Chile

P. Troncoso-Iribarren¹, C. Santander², J. Díaz³, H. López⁴,
E. Labbé⁴, I. Schacht⁵, C. Piña¹, C.A.L. Morales Marín^{5,6},
H. Drass^{3,7}, A. Barr Domínguez⁸

¹Escuela de Ingeniería, Universidad Central de Chile, Avda. Francisco de Aguirre 0405, La Serena, Chile. email: paulina.troncoso@ucentral.cl

²Departamento de Física, Facultad de Ciencias Físicas y Matemáticas, Universidad de Chile, Avenida Beauchef 850, Santiago, Chile.

³Instituto de Astrofísica, Pontificia Universidad Católica de Chile, Avda. Vicuña Mackenna 4860, 782-0436 Macul, Santiago, Chile.

⁴Núcleo de Astronomía, Facultad de Ingeniería y Ciencias, Universidad Diego Portales, Av. Ejército 441, Santiago, Chile.

⁵Coperativa de Trabajo Geodésica, Tirso de Molina 05264, Temuco, Chile

⁶Agencia Regional de Desarrollo Productivo de La Araucanía, Arturo Prat 0221, Temuco, Chile

⁷Centre for Astrophysics, University of Southern Queensland, West St, QLD 4350, Australia.

⁸Centro de Investigación Multidisciplinario de la Araucanía, Facultad de Ingeniería, Universidad Autónoma de Chile, Avenida Alemania 01090, Temuco, Chile.

Abstract. An Eclipse is an astronomical event that convenes a large audience. Few days before it, most of the community is aware of the event and the press is activated fully on it. The alignment recovers our most intrinsic human aspects, the curiosity, and enthusiasm for a natural phenomenon. This work is focused to enjoy and perceive it in three different ways: visually, listening, and in an artistic expression.

We focused on the construction of more than one hundred LightSound devices, which the main purpose is to record the light intensity and transform it into different tones. Besides, we created an artistic representation of the Eclipse motivated by the ancestral culture of the people residing in the totality zone. This music adds a sensorial joy to the eclipse event.

Keywords. eclipses, instrumentation: miscellaneous, instrumentation: photometers

1. Introduction

Bieryla et al. (2018) designed the electronic device, hereafter LightSound, which transforms the light intensity into different tones. This device permits to record and listen the differences of light intensity of certain light source. Pointing this device to the Sun, it emits an high-pitched sound, while during the Sun eclipse, and its gradual occultation, the sound changes from a high to a low-pitched sound. This device was used in the USA, African, and Argentinian/Chilean Eclipse in 2017, 2018, and 2019, respectively. In Chile, we received from the LightSound IAU100 Project† twelve devices, which we distribute

† <http://astrolab.fas.harvard.edu/LightSound-IAU100.htm>



Figure 1. *Left:* LightSound device for the Eclipse 2020 in Chile. The case was specifically design to adjust all electronic supplies and printed in 3D. In front, the light detector is placed. To the left side, the switch on/off bottom is located, the blue switch change between the tone and musical mode. The logo of our association “Astronomía Inclusiva” is on front of the image. *Right:* Thirty most used Spanish words in our application form to request a LightSound.

along the country. The enthusiasm of the Chilean people, requesting the device to different channels and persons dedicated to astronomical outreach, motivated this team to assemble the devices in Chile. For the Eclipse 2019, we were able to build five devices, so we recorded the Eclipse sound in 17 points along Chile. With these data, plus the one collected in Argentina, Allyson Bieryla and Soley Hyman built the Eclipse Sound Map[‡]. An extensive description of the original design and its use can be find in [Bieryla et al. \(2020\)](#); [Soley et al. \(2019\)](#). This development motivated our Chilean team to develop, build and communicate the concept to the Chilean community. We were awarded two project from the ESO-Comite Mixto and GEMINI funds to build one hundred LightSound (Fig. 1) and another one hundred Orchestar. The Orchestar device converts the light color into different musical tones, as it is explained in details in [Bieryla et al. \(2018\)](#).

2. Overview

In its original version, the LightSound transforms the light intensity into different tones, to listen this sound visit the following website https://youtu.be/_BM6IjDj-AM. We explore the possibility of considering different instruments for marking the intensity levels, as it can be listened here <https://www.youtube.com/watch?v=DtWXAyS-4s0>.

Transferring the concept to the community and device distribution: The LightSound and Orchestar devices can be used to explain various science topics using sounds. Yet, since the concept is unknown, people relate this device to a specific scientific experiment. Our main idea was to use the device during the Eclipse to reach a large part of the community, introduce the concept and continue with other experiments during 2021. Our original plans were to distribute the electronic supplies and build the devices in hands-on or co-work session with the interested people, specially in centers dedicated to astronomical Outreach and Universities. Due to the pandemic, we had to adapt this plan, distributing the assembled devices to the people, and rely in our developers team. The devices were distribute along Chile, from Calama to Punta Arenas, and in various Outreach centers such as Museo Interactivo Mirador, Las Campanas Observatory, Universidad Católica, Universidad de Chile, Universidad de Concepción and Universidad Austral.

[‡] <https://youtu.be/RraNpZkSxNY>

Description on how to implement MIDI sounds.. The LightSound works as an musical instrument. It plays the sounds based on the MIDI system, therefore it depends on the note, instrument and channel. The MIDI chip allows 15 channels, so there can be 15 instruments playing at the same time. The original version of the LightSound uses one channel which reproduce tones depend on the light intensity: more light intensity means higher pitched sounds, less light intensity means lower pitched sounds. In this version, presented in this contribution, we added a new feature: more light intensity means more instruments. To do this we employ MIDI songs. However, the LightSound reproduce the song in real-time using the MIDI commands, therefore it can not use the MIDI song itself, it is necessary to extract the instruments in the song before use it. We wrote a script to do this, which is available in the following website <https://github.com/cjsantander/SongToLightSound>. The output are the instruments of the song, where each file has the MIDI commands that LightSound can read. In this way, the LightSound read the instrument one by one and decide the volume of each instrument depending on the light intensity recorded in the sensor. We have to modify the original version of the arduino code to implement this new feature. The new code to play tones or multiple instruments is available in this website https://github.com/HenryDelMal/LightSound_ESP32.

Music creation and its connection with the Eclipse light curve. We have chosen two musicians dedicated to the etno-music, these persons have been reproducing the sound of antique instruments that has not survive until nowadays. They re-created the sound of these instruments with the historical information recompiled. The music created for this purpose is available in this website <https://portaldisc.com/disco.php?id=26771>. and use the following instruments, Antares (from Nazca culture), Rukos pinkullos (from the Cañari people of Ecuador), drum of agricultural use, and ceramic whistles.

Live transmission. We broadcast the sound of LightSound from the totality zone, in the locality of Lanco, Los Ríos Region. We organized this event dubbed “Eclipse Inclusivo” in collaboration with Centro de Estudios Científicos (CECs), and Centro Cultural de Promoción Cinematográfica de Valdivia (CPCV). Throughout the transmission, with interviews with authorities and representatives of the communities of people with disabilities, the device was playing in the background, capturing the variations of light in the environment, and every so often the transmissions were stopped to listen to it. This was replicated by 39 fanpages around the world, reaching 10,000 live reproductions, it is available in this website <https://www.facebook.com/ficvaldivia/videos/384101929485674>, a version with only image and sound was also broadcasted and it is available in <https://www.youtube.com/watch?v=qCg7M33CkiM>, for those who wanted to enjoy it.

3. Implications

This project was fully motivated for the enthusiasm of the Chilean people to get to know the concept of how the light can be transferred into sound. Besides the principal purpose of listening the Eclipse, most of the people found a second application of the device related to their daily life context. For example, some visually impaired persons said that they will use it to listen the sunrise/sunset or to know how dark/clear are their clothes. Most of the teachers commented on how to implement this device in their classroom, it is a experiment to mark the difference and feasible to do it online. The persons working on the Outreach centers mentioned their wish to include it in their regular activities related to Astronomy and other Sciences. The officer of the national governmental service dedicated to people with some declare impairment, SENADIS, mentioned how positive it is for their labour to include this type of device in their collections and offer it permanently to the community. Hereafter, we report some of the comments and use that persons declare to give to this device with their own words.

- Cecilia: I will use it to know when is sunrise and sunset, and share it with the members of the association for Blind people of the Araucanía.
- Alfredo: I will use it in two FONDART projects related to experiencing inclusion through theater. His records of the Eclipse in the Araucanía are published on the website <https://www.facebook.com/alfredo.s.santibanez/videos/10223220581358485>.
- Arturo: I will use it to detect lights switch on/off at home, to know if the clothes are dark/pale or the day is sunny/cloudy. His record of the Eclipse in Santiago are published on the website <https://www.facebook.com/astroinclusiva/videos/177093007481688>.
- Fundación Pequeñas Grandes Estrellas: We will incorporate the LS in our 2021 activities! aiming to make Astronomy closer to visually impaired kids.
- LCO outreach officer: We use it to broadcast the Eclipse in our youtube channel, https://www.youtube.com/watch?v=c84K0lceGVY&feature=emb_logo. Post Eclipse, we will work in collaboration with Dedoscopio.
- Marlene: I will keep it and try to listen the Moon and stars.
- SENADIS officer: We will keep it in our governmental records, as one of the project that impact positively to the Inclusion. The device will be available to individuals who request to use it.
- Maritza: I will incorporate this device to the set of activities that we have already create in the network of teachers “Nodo Andino de Astronomía”
- María: I have plenty of plans to use it post-eclipse. Once the face-to-face activities are back, I will add to the AstroBVI activities such as: inclusive station in the mobile planetarium of Science Faculty of PUCV and vulnerable schools in rural areas of Valparaíso.
- Lorenzo: I will use it in a school of the Elqui Valley, in which we teach to old people and some are visually impaired.
- René: I will use in the Optics lab for the Engineering students.
- Rodrigo: During the Eclipse, we will transmit live from the Radio & TV of Villarrica. Later we will incorporate it to the Dedoscopio activities.
- Juan: Enjoy the sunsets, and explain the eclipses in activities organized by my association “Astronomía en las calles”.
- Carla: I will perform some experiments for the eclipse and in outreach activities related to the Sun, mechanics of the sound waves and electromagnetism. I will transfer this concept to Peruvian associations dedicated to teach science to visually impaired.
- Jennifer: I will use it in the activities that I organize as an outreach officer of CATA and Universidad de Chile.
- Sonia: AUI/NRAO will use it in our activities focused on inclusion and gender equity.
- Museo Interactivo Mirador: we will incorporate it to our regular activities of the museum. In particular as a complement for the “Plaza Solar” of MIM.

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