Poster - Noiseboard Project: Using Sensors and Long-Range Wireless Communication For Musical Augmentation of Skateboarding

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The article discusses the *Noiseboard* project, a sensor-equipped skateboard that allows for creating music while skateboarding. Unlike previous projects, the *musical augmentation* of the board does not limit the movement possibilities of the skater who can do all the usual tricks. The project is designed to be a skateboard augmented with musical feedback primarily but can also be intended as a tangible interface for music performance based on the use of the skateboard. The system was created by embedding sensors and wireless technology in a novel way into a skateboard, and the technical choices and possible scenarios are discussed in detail. The system's feasibility and functionality were tested during live music performances, and current limitations and possible future improvements are presented.

CCS Concepts: • **Applied computing** → **Performing arts**; **Sound and music computing**; • **Human-centered computing** → **Systems and tools for interaction design**.

Additional Key Words and Phrases: HCI, DMI , computer music, skateboarding

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1 INTRODUCTION

Skateboards have been used to create musical instruments or interactive music systems, but they often alter the skateboard's original function. This poster presents the *Noiseboard* project, a sensor-equipped skateboard that allows for creating music while skateboarding. Our design augments the board with musical feedback without limiting the skater's movement possibilities. It serves as a tangible interface for music performance, augmenting the experience for skateboarders and expanding possibilities for music performers. The Noiseboard project combines embedded sensors and wireless technology to detect skateboard movement and generate sound. The system was developed in collaboration with a tangible user interface designer, an electronic music composer, and a professional skater. The article discusses technical choices, showcases real-world performance, and outlines future improvements.

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2 BACKGROUND

This paper explores a system that combines skateboarding and electronic music, two culturally significant activities that belong to the scope of the third wave HCI [4]. Skateboarding, originating in the 1950s, has influenced fashion, music, and art [3]. Electronic music, also from the 1950s, has advanced with computing technology [5].

The past two decades have extensively explored using sensors and Tangible User Interfaces (TUIs) for music creation. Projects like the Reactable [15] and the OP-1 by Teenage Engineering have demonstrated interest in tangible musical interfaces. Artists can create sensor-based instruments with tools like Arduino [16] and Daisy board. Academic research in this field, including LoopBlocks , thrives in the music interface making debate (e.g., [9, 21, 23]). Motion tracking has also attracted attention [10, 11, 19, 20, 26]

Embodied interaction [6] challenges mind-body dualism, drawing on phenomenology. Somaesthetics [25] emphasizes body movements, discussed by Schiphorst [24] and Höök [14]. Entanglement HCI highlights the performative relationship between humans and technology, reframing knowledge generation.

Skateboarding's impact on music, specifically within the punk rock genre, has been recognized [3], and skateboards have undergone a unique transformation into musical instruments. Notably, individuals like Nick Pourfard and Yuri Landman have crafted custom electric guitars, such as the "Skate-Caster" and "Skatar," respectively, incorporating skateboard decks as both bodies and necks. Furthermore, skateboards have found utility as percussion instruments and have been sampled in musical compositions.

In media and interactive art, skateboards are utilized as interactive controllers. Installations like "Concretism" by Zach Lieberman allow users to manipulate visuals and sounds using skateboards [17]. The BARCODE-BOARDING project by Ei Wada [1] uses barcode-equipped skateboards to trigger sounds and samples.

Research has explored wireless communication and sensors, including integrating compact circuits into skateboards to detect movements [12]. However, these research projects have technical limitations and are not targeted for actual skateboarding sessions or music performances.

3 NOISEBOARD DESIGN

The project aimed to develop a system that allows performers to use a skateboard in a musical performance while maintaining its nature and the interaction a skater has with it. The design process involved an interaction designer, a composer, and a skater actively involved throughout the development stages. The system was developed between 2018 and 2019 as part of a Street Art promotion initiative funded by the Culture Department of the City of Venice, Italy. The subsequent paragraphs will provide a detailed description of the team's operations in building the Noiseboard.

The project emerged from the friendship of the team members and aimed to create an augmented experience where skateboarders can make music while performing tricks. The team noticed a strong connection between skateboarding and music-making, but existing projects limited movement possibilities. This observation led to the idea of developing a small research project.

The team established several design requirements for creating the system. These include ensuring unrestricted movement, tracking the skateboard's full range of motion, and minimizing the technological augmentation's weight and size to avoid affecting the board's balance. The system, therefore, consists of these key components.

- skateboard(s) with microprocessor, sensors, and xbee embedded
- a receiver

[1] https://www.electronicosfantasticos.com/en/works/barcode-boading/

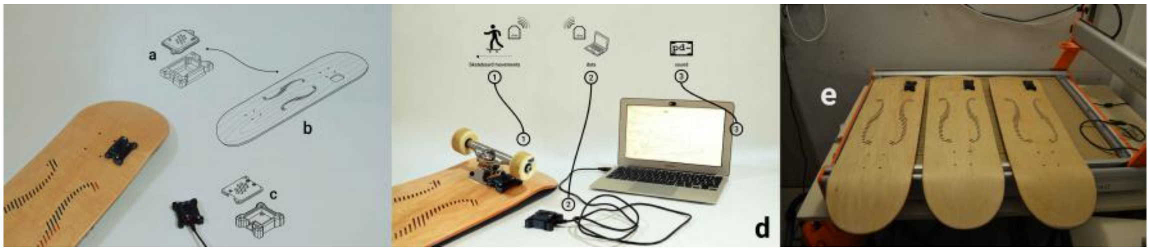

Fig. 1. the parts produced: casing for electronics on embedded in the skateboard (a); engravings milled on the skateboard (b) and receiver casing (c)

- a client software for interactive sound

The components needed are a textitsensor capable of detecting the skateboard's movements and converting them into data, a textitmicrocontroller that worked as a main computational device able to process the data processed, and a textittransceiver, capable of transmitting the data from the skateboard to a more powerful computer that can use the data to control sound related parameters. Besides their potential in terms of sensing, computing, and transmitting data, the team had to consider the limited space available on a skateboard and the consequent need for small-sized electronic components. They chose the Sense/Stage MiniBee board with an integrated microcontroller, Xbee connector, and built-in accelerometer [2]. Multiple MiniBee modules were used, with one as the receiver connected to a computer, and others on the skateboards, powered by a 3.7V LiPo battery.

The team integrated electronic components into the skateboard by designing custom-made 3D-printed cases attached to the lower part of the skateboard. They chose 3D printing in PLA for its compactness and lightness [7]. A CNC milling machine was used to engrave a niche in the board for component storage [8]. Graphic patterns resembling violin luthiery were engraved to highlight the musical aspect. Open-source CAD software, including FreeCAD and Inkscape, was used for 3D modeling and design [22]. Files and documentation were uploaded to a repository for wider accessibility[3]. Three Noiseboards were produced, with one equipped with an Xbee pro for long-range data transmission.

The sound design of the system was implemented using Pure Data, a visual programming language for interactive audio creation . The patch processes data from the skateboard(s) into Open Sound Control (OSC) messages, using axis variations to manipulate sound parameters and mapping the horizontal acceleration to overall sound amplitude. Random modulation variations create diverse sound effects for different skateboard tricks . The sounds emitted during the performance are inspired by hip-hop beats, with a main theme changing according to skate movements. Another patch in MAX, a different programming environment, was developed to test system flexibility .

4 THE NOISEBOARD IN PRACTICE

The Noiseboard was funded by the Culture Department of the City of Venice in Italy[4]. As such, we were able to organize a couple of public events to test the Noiseboard in public scenarios.

The two events took place at "Lido di Venezia" and at "Parco della Bissuola", where the team installed a half pipe structure and other kinds of skateboarding movable structures, together with a sound system for better audio diffusion. The initiatives were attended by approximately 200 people in total.

[2]https://docs.sensestage.eu/sensestage-v1/getting-started-with-sense-stage/unpacking-the-sensestage-kit
[3]https://github.com/chihauccisoilconte/noiseboard
[4]https://www.comune.venezia.it/it/content/noiseboard

The events were structured in a "workshop session" that consisted of a moment where the team explained to the audience how the system works and where people were invited to test the device and a music performance that was a moment where the team itself used the system to show to the audience its full potential

Fig. 2. pictures of the events at Lido di Venezia (a,b) and at Parco della Bissuola (c,d)

The sensor response and data transmission in the system were clear and without noticeable latency, and the devices proved to be durable during field tests. Out of the three boards produced, only one with the Xbee pro was usable in the music performance, while the other two had a limited range for the workshop session. The audience responded enthusiastically to the system, with young skaters finding the interactive experience enjoyable and expressing surprise at the technology. Older community members were impressed by the technical aspect and saw market potential for the product. The project was paused due to COVID-19 restrictions, remaining archived for two years.

5 CONCLUSIONS

The Noiseboard is a novel interactive skateboard that combines traditional skateboarding tricks and movements with interactive sounds. It preserves the skateboard's original function and mobility while introducing distinct sounds for each movement. The design process involved analyzing the skateboarder's actions and their embodied relationship with the board and its overall context in the ecology of use (on artifact ecology see [2, 13, 18]. This approach successfully creates an engaging interactive experience appealing to both non-virtuosic athletes and experienced users. The project utilizes sensors, microcontrollers, and long-range wireless communication, enabling artists to incorporate the Noiseboard into musical performances while retaining its characteristic features [1]. Although the project has limitations, it holds potential for further contributions to wider research debates, such as the Internet of Musical Things [1, 27].

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