

# SIMPATY-HAND APP, A MUSICAL INSTRUMENT DESIGNED FOR PEOPLE WITH LIMITED MOTOR SKILLS

*Carolina Valli*

Electronic Music and New Technologies,  
Conservatorio G. Verdi,  
Milan, Italy  
Carolina.valli@tiscali.it

## ABSTRACT

Simpaty - hand App is an assistive music instrument realized with a smartphone that enables you to activate and modify audio sequences or rhythmic patterns with minimal movement of the arms or legs, suitable and designed for people with limited motor skills. Thanks to an internal accelerometer managed in Touch-OSC [1], the data on the movements of the limbs are transmitted and sent to a pc application developed in Max/Msp [2], via a wireless network. This app allows you to load audio files that will be reproduced based on the movement performed by simulating the use of a real instrument, with three different modes of operations: percussive sounds, riffs and loops.

was a lack of interaction and active participation, hampered by difficulties in movement and the impossibility of using traditional musical instruments. Inspired by the gestures used in interaction with a traditional instrument, such as a maraca, with the aim of maintaining the link between gesture and sound, the idea of using a common device such as the smartphone, able to take advantage of residual movements and adapt to most patients unable to make articulated movements. The realized instrument gives an extra possibility to those who, for the reason of accidents or illnesses, are not able to use any musical instrument but still want to express themselves and interact actively while participating to music performances. With this tool it easily becomes possible to control audio sequences or rhythmic patterns with a single and simple movement.

## 1. INTRODUCTION



Figure 1: Simpaty-hand App

The project was born as a bachelor degree thesis in collaboration with the center *Sim-patia* in Valmorea (Italy) [3], a structure that houses a day center rehabilitation and some housing units equipped for the needs of disabled people with severe disabilities. In the centre there were already music therapy activities that were often passively experienced by people with serious motor problems. There

## 2. CURRENT STATUS OF THE PROJECT

After initial theoretical research in the field of AMT (Assistive Music Technology), I started to design the Simpaty-hand app. I was inspired by a project of Perry Cook, the PhISEM Shaker Percussion that uses values of internal sensor to send MIDI commands to control a simple algorithmic jazz combo of bass, piano, and drums. In a simpler way I thought to use the internal sensor of the smartphone. The success with both adults and children, said Cook in his consideration about Principles for Designing Computer Music Controllers [4], in particular about the Frog Maraca, came from its simple interface (just shake it). Simpaty-hand App has been designed to help some of the members of the band present in the center in which I worked, to overcome their difficulties while performing with the band. They needed a musical instrument with an accessible and universal design, as Brendan McCloskey said when he describes design ethos in accessible design [5]. These are the main characteristics:

1. Wearable
2. Light
3. Easy and intuitive to use
4. Capable of using minimal movements
5. Which uses low-cost technologies

Hence the idea of using a smartphone which, thanks to its internal accelerometer, could easily detect data related to limb movements and send them to a PC application that has been developed with the Max/Msp software. It allows to load audio files and to play them according to the movements of the performer. The application provides three different playing modes for activating recorded music patterns such as percussive sounds, riffs and loops. An audio engine and a



calibration process are managed within the Max/Msp application on the pc. The prototype has been used by the band with positive results [6] and could yet be improved by developing an Android application that combines data acquisition and sound management on the same hardware and software platform in order to make a free use of an application for smartphone. It also remains to experiment it's use on a smartwatch with an Android operating system that would be even a lighter controller.

### 3. MAIN APP FEATURES

The main functions of the Simpaty-hand App are :

1. Data acquisition from the smartphone sensor;
2. System calibration according to the typology of gesture made by the performer with the device;
3. Data pre-processing (data filtering, onset detection, segmentation);
4. 3D acceleration data processing and mapping the final use and control of the audio engine.

To easily manage data acquisition, device calibration and audio synthesis, a graphical interface with pop-up menus has been developed.

### 4. GRAPHICAL INTERFACE

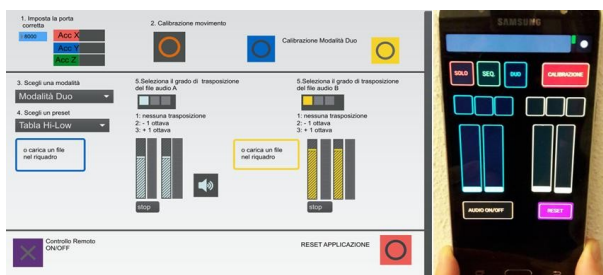


Figure 2: GUI with 3 main sections and remote controls on the smartphone

The graphical user interface is almost entirely based on pop-up menus to easily guide the user through a step by step configuration procedure. The interaction with the GUI requires fine motor control and it is usually managed by a caregiver or session organizer. It can be divided into three main sections.

#### 4.1. Set up and calibration

In the first section you must set the communication port between the two devices that allows you to receive data from the smartphone and perform device calibration. Sensor values are displayed graphically and serve as feedback to verify whether the two systems are communicating correctly.

#### 4.2. Choosing how to play and playing audio files

The application recognizes two different states based on the movements made on the device: an ON and OFF state. You can choose one of the three execution modes from a pop-up menu.

1. Solo mode: suitable for playing an audio fragment that will be activated (On) and stopped (Off) depending on the movement performed, such as when a key is pressed on the keyboard.

2. Sequence Mode: alternating the On/Off states it is possible to control the execution of an audio sequence (On) that can be interrupted (Off) and restarted from the point where it was previously stopped (On).

3. Duo mode: Alternating the two On/Off states, you can control two different sounds, suitable for different percussions .

For each mode you can use a default sound or upload an audio file in the window, dragging it with the mouse. Afterwards you can set the playback speed of the audio file and adjust its volume.

#### 4.3. Additional Controls

Two additional controls are used to enable the remote control or to reset the application to its initial state. The remote control is possible thanks to the graphical interface developed in Touch-OSC that help to control from smartphone the volume, calibration or playback mode.

### 5. PRACTICAL CONSIDERATIONS AND USER EXPERIENCE

Simpaty-hand App was tested by Elena, a woman with paralysis of the right side of the body and limited left forearm movements. One of the problems encountered during the use of the device is the tendency to change movement during the execution of the same piece and therefore the need for new calibrations. For this reason, a motion filtering system was used that does not take into account sudden or undesired movements made within 240 ms. As far as latency is concerned, no particular problems were encountered using a hotspot connection between the two devices. As you can see in the video, the Solo mode was more suitable and in line with the needs of the band, used with the sound of maraca. The Duo mode has been experimented as an accompaniment to the rhythm of the drums and needs, as with any traditional instrument, Elena's learning of the rhythm to be performed according to the time marked by drummer. The Sequence mode was used as the basis on which the other band members improvised. From the feedback received and the tests carried out with the band has emerged the intention to continue using the Simpaty-hand both with Elena and to involve other guests, currently the app is available to the structure I worked with and it's still in the testing phase. For now, there aren't enough feedback or users who have tested it to carry out a survey or a more precise statistic of its use but remain the will to experiment and to make it known in the rehabilitation field as well as in music therapy.

### 6. SCALABILITY IN DIFFERENT CONTEXTS AND APPLICATION FIELDS

The instrument can be calibrated according to the motor skills and movement needs for each performer and can be used with a bracelet or without. In addition to being used as a musical instrument in groups or individually, as a

recreational activity, the application could be experienced as a rehabilitation aid. For example, to stimulate the accomplishment of painful or difficult movements. It could be less demanding for patients if rehabilitative activities were associated with sounds or audio tracks. Playing audio when the movement is correctly performed could particularly help children who would face rehabilitation as if it was a game. The main features of the tool such as simplicity of use, portability, adaptability, lightness, practicality and use of a common device such as the smartphone, makes it possible to use it in different contexts. In particular minor structures, with little money to invest in such as Schools, Rehabilitation Centers, Private, Associations, Hospitals, Leisure Centers, Health Residences for the disabled or Cooperatives.

## 7. POTENTIAL SOCIAL IMPACT

At a social level, the use of an instrument that can involve all the people who have more difficulties in music therapy contexts, concerts or during moments of recreation contributes to create a network of friendships, to promote communication and reciprocal knowledge while creating a framework of cooperation between patients, their families and the health staff. This type of aid can also be considered as a psychological support. Communities may create situations of interactions between all their actors which go beyond strict music therapy sessions. They can give birth to other musical realities, for example small bands that are involved in external and social activities such as concerts or events, increasing both self-esteem and well-being of all the involved people.

## 8. FUTURE DEVELOPMENTS AND ACHIEVEMENTS UP TO NOW

Simpaty-Hand App has been selected for the competition "Make to Care 2017" [7] organized by the Sanofi Genzyme Company among the top 10 finalists. It also has participated in the "Maker Faire" of Rome 2017 [8] and in the competition organized by the City of Milan "Call for Solutions: Open Innovation for Community Care" [9] within the Open Care project where it arrived among the top 3 winners. My future goal is to enhance the project and to develop an app for smartphone to be distributed in different facilities. I'm particularly interested in the rehabilitation field and I'd like to extend the original project by using more sensors to capture different and simultaneous movements, in order to control more sophisticated musical situations by introducing audio effects or acting on expressive parameters during performance.

## 9. REFERENCES

[1] <https://hexler.net/software/touchosc>

[2] <https://cycling74.com/products/max>

[3] <http://www.sim-patia.it/index.php>

[4] [http://www.nime.org/proceedings/2001/nime2001\\_003.pdf](http://www.nime.org/proceedings/2001/nime2001_003.pdf)

[5] Samuels K., (2014), "Enabling Creativity: Inclusive music interfaces and practices", in International Conference on Live Interfaces 2014, Queen's University Belfast, Northern Ireland

[6] [https://drive.google.com/drive/folders/0B7\\_KtlzguBbUOU5xSFk4SGlsVGs](https://drive.google.com/drive/folders/0B7_KtlzguBbUOU5xSFk4SGlsVGs)

[7] <https://www.maketocare.it>

[8] <https://2018.makerfairerome.eu/it/espositori/?ids=1894>

[9] <http://opencare.cc>