UNIVERSITÉ DU QUÉBEC À MONTRÉAL

COMMUNICATING THROUGH THE CREATION OF A DIGITAL MUSICAL INSTRUMENT

MEMOIRE

PRESENTED

AS A PARTIAL REQUIREMENT

FOR A MASTERS IN COMMUNICATION

BY

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COMMUNIQUER À TRAVERS LA CRÉATION D'INSTRUMENT DE MUSIQUE NUMÉRIQUE

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PAR
LEONARDO BORRERO LUZ

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TABLE OF CONTENTS

FIGURES

LIST OF ABRIVIATIONS

UQAM	Université du Québec à Montréal
DMI	Digital Musical Instruments
AMI	Acoustic Musical Instruments
CG	Computer Graphics
HCI	Human-Computer Interaction

DEFINITIONS

In the Research-Creation Project described here, I use the terms WOBL *musician, instrumentalist, player, woblist, performer, artist* and *user* interchangeably. This is because of the inherent nature of the digital WOBL instrumental performance, which involves a number of unique WOBL features: the WOBL artist(s) visual gestures, the WOBL auditory signals (sounds), the WOBL disks' movement, the finger manipulation feedback from the WOBL to the artist, and the audio-visual experience of audience members.

RÉSUMÉ

Dans cette recherche, nous désirons vérifier si en communiquant explicitement à l'auditoire, il existe une corrélation entre les gestes d'un musicien et le son entendu, et si ça joue un rôle important dans la qualité expressive et dans l'appréciation d'un spectacle de musique en direct. Pour ce faire, nous élaborons un instrument de musique numérique appelé WOBL, qui tente de communiquer ce concept. J'ai travaillé en tant que chef de projet du WOBL, sous la supervision de Jean Décarie, professeur à l'École des médias de l'UQAM, et j'ai recruté plusieurs artistes étudiants afin de m'aider sur certains aspects de ce projet. Ensuite, nous avons exploré comment les gestes exécutés lors de l'utilisation du WOBL peuvent contribuer aux qualités expressives de cette performance. Malheureusement, les performances n'ont été limitées qu'à moi-même et un autre artiste (Guillaume Dubois). Ces performances ont été enregistrées dans une variété de représentations publiques et individuelles. Même si la réaction des publics a été positive pour les performances réalisées avec l'instrument, leur documentation est limitée et n'est pas suffisamment exhaustive pour les inclure dans cette recherche. Néanmoins, notre observation et l'analyse des gestes produites lors de l'utilisation du WOBL montrent que les caractéristiques intrinsèques de l'instrument génèrent des relations directes avec ce qui est communiqué lors d'une performance.

MOTS-CLÉS: communication, médias interactifs, instrument de musique numérique, embodiment, WOBL

SUMMARY

In the present research project, I designed and built a new digital musical instrument, called the WOBL. This invention was based on theories related to expressive gestures in live musical performance, with the intention of potentially building an instrument that would qualitatively influence its performance. I worked as the WOBL project leader, under the supervision of Jean Décarie, Professor at the School of Media at UQAM, and recruited several student artists to help me with parts of this project. I investigated how the WOBL artist's gestures added expressive qualities to their performance. Unfortunately, I studied only a limited number of public and private WOBL performances, featuring as artists (woblists) me and Guillaume Dubois. Although the audience reactions were generally positive to the WOBL performances, the limited documentation of this interest was not enough to include as an outcome of this research project. Nevertheless, by qualitatively analyzing video recordings of WOBL performances, it was possible to conclude that the artist's gestures produced when manipulating the WOBL contributed to the meaning of the performance for both the WOBL artist and for audience members.

KEYWORDS: communication, human-computer interaction, digital musical instrument, embodied cognition, WOBL

INTRODUCTION

Audience dissatisfaction has widely been noted regarding musical performances with digital media. Gagnon (2014) provides a clue by explaining that the challenge resides in paying attention to the presence or absence of the expressive qualities of a performance when conceiving a digital musical instrument (Wanderley, 2008).

In the present research project, I went through the creative process of conceptualizing and inventing a novel digital musical instrument, the WOBL (Elfassi, 2012), which attempts to address this audience dissatisfaction, by incorporating certain qualities found in live performance of acoustic musical instruments. I started this project by with ideas from McLuhan (1967) and Maeda (1999) as an initial theoretical understanding as to why the object (musical instrument) that I was going to create, would communicate a particular experience to the audience, but later discovered that meaning from gestures was at the center of communicating an experience. Thus, more pertinent theories, such as embodiment, mirror neurons and autopoiesis, allow me to form a hypothesis of how and why the design of the WOBL, when used in a performance by a woblist, communicates meaning. The center of this theoretical discussion as well as the design of my project focuses on how the WOBL provides an explicit causal relationship between each of the performer's gestures required to manipulate the WOBL, and a particular digital sound generated by the WOBL.

In this research, I mainly use an exploratory research method as I am more interested in how and if the WOBL affects the gestures of the performer in a desired manner. The research does not validate if the WOBL attenuates the dissatisfaction present in musical performances with digital media, and this could be a direction for further research. Nevertheless, this opens up a discussion on defining what the WOBL is, particularly to the eyes of the audience viewing the performance.

CHAPTER 1
RESEARCH CONTEXT

In the following chapter I will discuss how I understand interactive media. This is important for it sheds light on the reasoning behind the production process.

1.1 Challenge

The initial idea for this project originated during a course on interactive media offered by UQAM's Communication Department, the Director of Collections at the *Cinématèque québécoise*, Jean Gagnon, when he gave an interesting lecture to students about the challenge of *digital musical instruments* (DMI) (Wanderley, 2008). According to Gagnon, one of these challenges is the miniaturization of interfaces, such as keyboards, nobs and sliders used for electronic music devices (e.g. computers, MIDI controllers, synthesizers), which reduce the character and expressivity of the artist's performance (Gagnon, 2014, p. 55).

To put this in context, let's begin by segmenting three concepts of a performance with an instrument and present how they interplay with each other. In Gagnon's (2014) doctoral thesis, he presents the following three concepts: Firstly, the concept of the *composition* of the instrument played (which we will elaborate more in chapter 4). It is the central element in the triadic relationship of a performance for it defines the following two concepts. The second concept of this triad is the *instrumentalist*, corresponding to the person who plays the instrument and who is central to the variability of the performance. The third concept is the *content* (my translation from *matériau*), which is the audio-visual output structured (or composed) by the *programmed variability* of the instrument (Gagnon, 2014, p. 272). During a performance, each one of these three elements are closely affected by each other. The *composition* of the instrument affects the way in which the *instrumentalist* can play the instrument and consequently affects the *content* that is presented during a performance (Gagnon, 2014, p. 122). This includes the gestures of the *instrumentalist* as well as the rhythmic qualities of the musical piece performed.

Gagnon explains that the intentionality behind the instrument's *composition* guides the manner in which the instrument is played. This means that both of the other elements (the *instrumentalist's* way of playing and the way the *content* is manipulated) must be considered when *composing* the instrument's interface, such as how the instrument's digital interface is mapped, and how the audio and video effects are generated during a performance (Gagnon, 2014, p. 249). Gagnon's approach provides a compelling framework for exploring the elements that constitute a performance and is the base upon which I will address my creative project.

1.2 Research Objective

Gagnon's understanding of instruments strung a cord with me for I found that certain concepts he presented echoed with McLuhan's (1967) important insight that *the medium is the message* which I had discovered previous to this work.

In my understanding, the medium is the message in two ways. First, the medium is the message to the extent that it defines the content distributed through it (e.g. the television, the format of the daily news, etc.). Second, the medium is the message given its aesthetic qualities (e.g. the television's place in a house, it's size, it's channels, it's brightness, etc.), and these affect the behaviour associated with receiving this content, which contributes to the meaning given to the content (Kane, 2011). In other words, the medium is the message, because it heavily defines the content and the meaning given to it. McLuhan's concept of the medium resonates with Gagnon's triad, which explains how an instrument used in a performance has an important influence on both the *instrumentalist's* way of playing and the rhythmic structure of the *content,* in spite of the *instrumentalist's* will.

Given the above considerations regarding McLuhan's and Gagnon's work, I decided to apply this idea to the creation of a *digital musical instrument* (DMI). This would allow me to see if there is a possible relationship between the *qualities of an interactive object* (established by specific intentions) and *their cultural determination* (produced through meaning associated to these objects), which emerges from a cognitive process that results from experiencing the object. The creation of a novel DMI would fulfill the requirements for my UQAM Master's Research-Creation Project, since the process of experimenting with and defining a new musical instrument would allow me to actively integrate the challenges of conceptualizing, producing, observing, and analyzing media and its content.

1.3 Creative Approach

To undertake the conception and production of an interactive media, it is important to have a certain view on this media. In the same way the Bauhaus movement represented a design philosophy for architects and designers, John Maeda and the design culture I discovered through him are central to my views in this field.

John Maeda (1999) became a leader in the field of *computer graphics* by introducing *Design by Numbers,* a project that illustrated the importance of programming to designers. Importantly, Maeda (1999) suggests a specific approach through his project. This approach is based on the idea that the code and the technical device (in this case, the computer and computer screen) are the underlying expressive aesthetic of the visual outcome. Maeda's students, Casey Reas and Ben Fry, explain this approach "as an artistic project [...] [which] embodies the idea that patterns are aesthetic and are produced by a recurrent processing of functions defined in code" (Reas and Fry, 2007). In other words, this approach perceives the world as a place where "incredibly simple rules can produce incredibly complicated behaviour" (Wofram, 2008) all while being "a system that you can intuitively understand" (Snibb, 2012, 17:10-17:15).

Taking into account Maeda's approach, which is fundamental in computer art and interaction design, it was difficult not to see a digital instrument as a programmed code executed by the *instrumentalist*, who could produce a relatively determined expressive aesthetic in the form of an audio-visual performance. To a certain extent, my WOBL Research-Creation Project views human behaviour as an aesthetic activity.

1.4 The Intention Built Into the WOBL Instrument

Gagnon's (2014) discussion about the miniaturization of interface components reflects a general disregard among digital instrument developers for the importance of the instrument artist's gestural and postural movements during performances, and the developers' lack of effort to eliminate screens, buttons, and sliders (which control the digital instrument during performances) without falling into *motion capture* (Gagnon, 2014, p.64), a technique were gestures are captured by a digital video camera and interpreted by software. Luckily, the multi-sensorial experience of *acoustic musical instruments* (AMI) and their expressive qualities in the context of a performance seems to have all the ingredients that we so much desire.

A phenomenological survey differentiating the feelings experienced by audience members hearing either DMIs or AMIs sheds light on this challenge.

This large amount of research and development in the field of musical tools (where most of the interesting research comes from academia and DIY people - as opposed to the commercial sector) is also a response to the unsatisfactory feeling that the audiences of computer music performances tend to have, due to the lack of perceptual **causality** between the body gestures of the musician and the resulting sound. This lack of causality is not found in performances using acoustical instruments and people are realising that it is not just a matter of "getting used" to the new mode of disembodied performance of the laptop performance, as fundamental to musical performance is the audience's understanding of the performer's activities, a sharing of the same "ergonomic" or activity space (Magnusson and Hurtado, 2008).

In order to use this observation in the context of my WOBL Research-Creation Project, I used a bottom-up conceptual framework to analyze and create interactive media, developed by Paquin (2008), named the *rhetoric of interactive media.* This framework constitutes a *lexicon* that facilitates the emergence of a coherent conversation about the *grammar* that defines the live experience of interactive installations, objects, applications, etc. To expand this lexicon, Paquin suggests a methodology in which each new *figure of speech* observed for an interactive object and its respective experience is added to the repertoire of *figures of speech* in interactive media. An object's *figure of speech* is the stylistic quality of the object. For example, both the repetitive motion produced by a motor and the contrast in size between two elements in an installation, cause experiences that are specific to the *qualities* respective to each object. Altogether they constitute a *grammar* that could be used in the context of creative processes and research analyses.

In the case of musical instruments, the perceivable **causality** *"between the bodily gestures of the musician and the resulting sound"* is the stylistic quality of the object that reflects the live experience provided by the object. This quality has a plethora of other repercussions that are far more complex and subtle than we would like them to be and that characterize the "dramaturgy of the body-instrument" (Gagnon, 2014, p. 238).

The complete human experience of live performances is far too complex to consider within a single research project, given the infinite number of elements that define it. Hence, the relevance of the approach suggested for the present research-creation project, is that it narrowed my attention down to two simple stylistic rules observed in music instruments: 1) clearly expressing the causality of the gesture of the *instrumentalist* and the sound generated by the digital instrument; and, 2) exaggerating the interface related to the digital instrument's mechanism of sound production.

CHAPTER 2
RESEARCH-CREATION

2.1 First Version of the WOBL

In order to make evident that the mechanism of the WOBL digital instrument was related to the sound generated, I first inspired myself with instruments whose mechanical functioning was very apparent. The ones that came to mind were the *bagpipe* and the *accordion*. I felt that the space needed to contain the air to make these instruments function occupied an important portion of the instrument. The movement and effort to expel the air from the compartments was also evident. For these subjective reasons, these instruments seemed to be a good starting point.

In order to justify the digital properties of the WOBL digital instrument I was developing, I focussed on the *air container* idea of the bagpipe and the accordion. The WOBL *container* would store sound instead of simply air. The sound was also to be stored in the correct temporal sequence, to later be expelled in the same sequence as it was saved. In other words, it recorded sound and later played it back once the sound was released. Visually, the recording of the sound would physically fill the instrument's compartment.

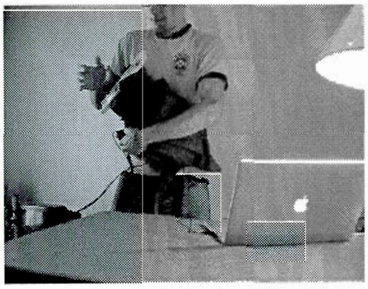


Figure 1: A photograph of myself and the first version of the WOBL instrument.

As you can see in **Figure 1**, the brown material body of the instrument served to represent the sound container. The artist's right hand produced the sound by scratching and tapping on the surface of the top of the instrument, similar to both a *guiro* and a *djembe*. The sound was then registered or expelled in the container depending if the artist's left hand opened the container or closed the container. Unfortunately, several aspects of this first model failed to communicate the idea that I wanted this instrument to express. Firstly, the container did not expand or contract to explicitly express that something was filling the space and that the sound physically was being expelled, as in the case of the air analogy. Secondly, the artist's left hand movement that controlled the containing and the releasing of the sound was not evident enough. The container was controller by pressing a hidden computer mouse masked within the instrument. This further emphasizes the fact that the artist's hand movement was relatively limited and it needed to be enhanced in order to be more evident to the audience.

2.2 Second Version of the WOBL

The initial idea of storing sound in a container was relatively abstract and mechanically complex to demonstrate visually. In this second version of the WOBL, I attempted to make the instrument's mechanical link with the generated sound more evident, as well as to further exaggerate the artist's gestures that activated the sound.

In this second WOBL version, springs were used as the representational sound generating mechanism. Springs fulfilled the first requirement because they are visually representative of the sound they make. A direct relationship exists between the sound and the size of the mechanical movement of a spring. As they are bent and released, they produce a "boing" sound, as they move back and forth. It's also apparent that the "Boing" sound produced by a spring decreases in amplitude at the same time that the amplitude of the back and forth movement of the spring decreases. The "boing" sound's initial amplitude is also related to the initial energy input by the musician that is required to displace the spring.

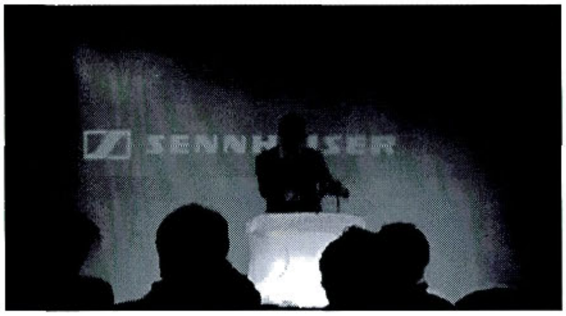



Figure 2: A photograph of me setting up the version 2 WOBL instrument (left).
Figure 3: A photograph of me performing with the version 2 WOBL instrument (right).

As you can see in **Figures 2 and 3**, the aligned springs were placed in such a way that an exaggerated arm movement is required by the user to activate them. They are also fairly large springs, which both promotes a larger artist hand movement to actuate the springs, and also makes the mechanism of the springs more visible to the other artists in the group and to the audience. In this version 2 of the WOBL, the set of aligned springs had various frequencies and tones.

Technically speaking, the back and forth movement of the springs did not produce any actual sound, unlike the vibrations of guitar chords that are struck. The springs in this second version of the WOBL did not vibrate fast enough to product such a harmonic sound. What it did do was enable the audience to see that the springs were wobbling back and forth with the sound in relation to the sound being generated by the instrument, and this made the version 2 WOBL instrument's mechanism more perceivable. To do this, a sensor captured the slow oscillating speed of each of the wobbling springs, and dynamically created an appropriate digital "boing" sound relative to the frequency of the spring's back and forth movement. The illusion was found to be pleasing for both the WOBL artist and the audience members.

2.3 Third Version of the WOBL

What came out of version 2 of the WOBL was that the spring movement and amplitude were good audio-visual indicators that a mechanism was linked to the sound generated by the instrument. The only problem was that the object visually consisted of four springs. It didn't have its own unique visual entity. The artist's gestures produced to play the WOBL instrument were not unique. They had the same gesture patterns as pulling levers or plucking springs. The WOBL needed a unique and distinguishing gesture signature. Due to this, a large part of the work to develop the third version of the WOBL was to keep the same mechanical logic as version 2, but to change its shape so that it was more unique.


Figure 4: Photograph of Guillaume Dubois playing version 3 of the WOBL (left).
Figure 5A: Photograph of me playing version 3 of the WOBL (right).

Figure 5B: Photograph of a djembe (from Wikipedia.org/wiki/Djembe).

As you can see in **Figures 4 and 5A**, version 3 of the WOBL instrument resembles a *djembe* (shown in **Figure 5B**), a rope-tuned, animal skin-covered, wooden African drum. The djembe artist can produces a variety of sounds, depending on where and how hard he taps the drum skin. The version 3 WOBL mechanism is very different from that of the djembe because the WOBL has five independent rotating discs. Each disc has a mechanical resistance that makes it move back and forth when "plucked", as with springs. The overall configuration and mechanism of the WOBL suggests a unique method of manipulation of this instrument by the artist. The format of the WOBL instrument generated a unique artist's gesture, called **wobling** which resembles that of a DJ scratching a vinyl record, yet the portability of the instrument and the configuration of its discs, makes the wobling gesture also resemble that of strumming a guitar, despite the different instruments' silhouettes. An artist manipulating a WOBL is called a *woblist.*

To provoke this new artist's gesture (the wobling), it was important to keep in mind the initial intention of the project when conceptualizing the mapping of the wobling disc interface and the sound generated. In keeping in mind the causal relationship between the instrument and the sound, two parameters had to be considered in the mapping of the interface; the speed of the WOBL's turning discs and the offset position of each disc in relation to its resting position. The speed parameter suggests a violin bow rubbing on violin cords, where the force and speed of the friction determines the amplitude and also the tonal quality of the sound produced. Similarly, the WOBL's discs were mapped to modify the amplitude and tonal parameters of the sound generated, according to their speed and rotating angle. The mapping of the WOBL's discs and the sounds synthesized were programmed using MAX MSP programming software for media.

Furthermore, the mechanical resistance of the WOBL's discs also gives a haptic sensory feedback to the artist when rotating the WOBL's discs. The mechanical force of the feedback increases as the rotation angle increases, so that a direct sensorial correlation between the mechanism of the instrument and the sound generated was felt by the artist.

The diameter of each of the WOBL's discs is approximately 20 cm, with each disc having a height of about 2.5 cm. The total length of the instrument is approximately 64 cm. Each disc contains a specialized sensor to track its position and speed. The sensor data is linked via a USB cable to a computer running the MAX MSP patch. A more technical detailed description of the instrument can be found in Annex A.

CHAPTER 3
OBSERVATION OF GESTURES

3.1 Methodology

The *agile* methodology has been increasingly popular in the past few years, in development circles. This method was presented by my Research Director, Jean Décarie, as a favourable method in the context of Research-Creation Project. As it is possible to see in the various iterations of my in Chapter 2, this is the methodology I used.

I have opted for a very lean exploratory research study. This type of research is informal and constitutes a close collaboration between the participants, rather than employing extensive documentation. The objective of this exploratory study is to examine the effectiveness of the preliminary design concepts. (Rubin, 2008)

For this exploratory research, the WOBL was played both by me and by Guillaume Dubois, a volunteer performing musician. These play sessions were documented by video recordings. The documentation was created throughout the various trials of the instrument. This iterative process lasted from May 2013 to August 2014.

When observing the videos, the main focus was on the activity related to gestures and sound, since these elements are both interdependent to the WOBL's mechanism as previously explained in section 1.1 of Chapter 1 when citing Gagnon. In the following chapter, I classify various observed gestures. This validates one of the study's instrumental goals, which was to produce a more exaggerated gesture.

3.2 Terminology

To help me describe the observed gestures, I turn to Marcelo M. Wanderley; CIRMMT Director, William Dawson Scholar, Associate Professor, Music Technology Department of Music Research at McGill University, Faculty Member, IDMIL. He has done much in segmenting various types of gestures in the context of musical performance. He claims there are three distinct *instrumental gestures*. (Wanderley, 2007) They are *effective gestures* – necessary to produce the sound; *accompanist gestures, also called ancillary gestures* – associated body movements; and *figurative gestures* – without direct correspondence to a physical movement. Benoît Bardy, also from McGill University, explains in her study "Music & Posture" (Bardy, 2009) how the *accompanist gesture*s (e.g. torso movements in pianists) and *effective gestures* (e.g. blowing, bowing, plucking a string, etc.) give "information about performer expertise, gender, musical style, and even the recognition of a specific performer". Such information, implicit in gestures, then contributes to the meaning expressed in a performance.

3.3 Observations

Two types of WOBL artist gestures were recognized and distinguished when observing video recordings of WOBL performances by Guillaume Dubois.

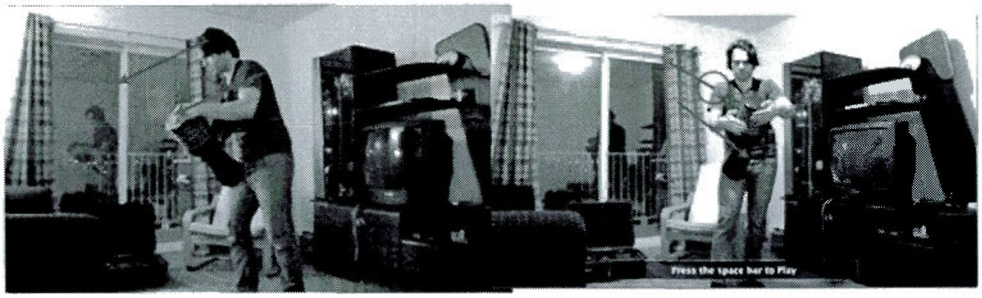


Figure 6: Photograph of Guillaume Dubois moving his entire torso flowing with the WOBL sound. (Accompanist Gestures) (left).
Figure 7: Photograph of Guillaume Dubois jerking his arm and shoulder in order to manipulate the WOBL instrument (Effective Gestures) (right).

3.3.1 Accompanist Gestures

[Accompanist gestures] have an intrinsic relationship with the music, representing a link between the music and the expressive intention of the musician (Davidson, 1993). Wanderley (2002) showed that ancillary [synonym to accompanist] movements occur frequently in musical performances, even though these movements are not essential for musical performances. Furthermore, these motions varied considerably between performing artists and were more consistent for a given artist. These movements are not randomly performed, but rather are used to communicate holistic musical expression (Wanderley & Vines, 2006).

The performing artist's intention and the musicality of the song are what seem to determine the expressive quality of these gestures, rather than the mechanical aspect of the instrument or its interface design. Furthermore, a performer's gestures seem to more important than the instrument itself, and these gestures retain their expressive quality, whether the performer plays the piano or the saxophone.

3.3.2 Effective Gestures

In contrast, effective gestures are less likely to be related to the melody or to the performing artist, and more likely to be determined by the instrument. We could say that these gestures enable the melody rather than accompany it. These gestures are more related to the artist's manipulation of the instrument. Nevertheless, they contribute as much, but in a different way, to the expressive qualities of the performance.

Due to the fact that effective gestures are more closely related to the instrument's design, we mainly focussed our study on these types of gestures.

In one of my first recordings with Guillaume Dubois, he first showed me what he wanted to do with his keyboard, and later I tried to create a similar sound with the WOBL. As I reviewed the recordings of this first session, I noticed that the effective gestures he made when playing his synthesizer keyboard occupied a smaller amount of screen space compared to the gestures he produced to manipulate the WOBL. I noticed that the effective gestures done on the keyboard or the WOBL were not necessarily more or less expressive, in terms of what they signified, but rather that one was a lot more perceivable (to the musician and the audience) than the other.

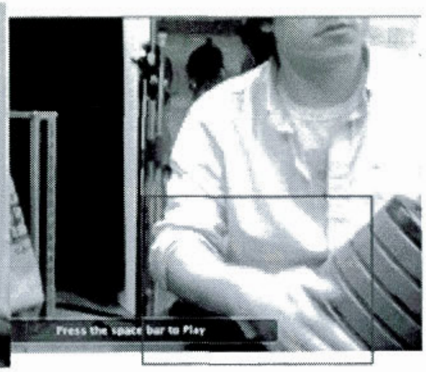


Figure 8: Guillaume Dubois playing his Nordwave synthesizer keyboard (left).
Figure 9: Guillaume Dubois controlling his keyboard though a WOBL interface (right).

It is important to note that amplification of the movement of the effective gesture is more perceivable because a larger movement involves other parts of the body as well. In a larger movement, the hand, the arm, the shoulders and even the torso are part of the movement. This makes the movement more obvious to other musicians in a group and also to audience members.

In brief, the design of the instrument can exaggerate the effective gestures of the musician, allowing their gestures to be more obvious, thus facilitating what they want to express. In summary, Guillaume's effective gestures were being determined by the functionality and design of the WOBL's discs.

3.3.3 Elaborate Effective Gestures

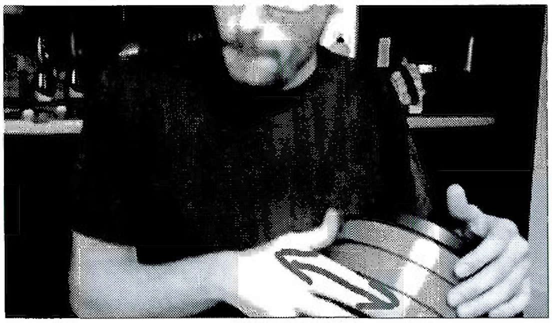


Figure 10: Photograph of me making a basic back and forth effective gesture on the WOBL, called the wobling gesture (left).
Figure 11: Photograph of me making a more complex effective gesture while playing the WOBL, called the swiveling gesture. This movement is reproducible by motor-memory (right).

As I became familiar with playing version 3 of the WOBL, I developed during an improvisation session, a particular effective gesture different from the habitual gesture of moving the discs back and forth. I developed a unique two-disc hand movement, called *swiveling*. One disc is held by the thumb, while another disc is held by the little finger. As I rotated my wrist, simultaneously moving the thumb and the little finger in opposite directions as I moved my arm back and forth, the swiveling gesture produced a swivelling, galloping wave sound. The swiveling effective gesture required a specific coordination of the arm and hand. It produced a very unique sequence of sounds that I was only able to reproduce with this same gesture. The swiveling motor-specific gesture only worked with the particular WOBL configuration of interface, mapping and sound synthesis that I used in this study.

CHAPTER 4
THE EXPRESSIVE QUALITIES OF A WOBL PERFORMANCE

In Chapter 3, it was noted that the instrument produced various types of perceivable gestures. In this chapter, I attempt to deduce through comparative studies what way this instrument can communicate meaning.

This deduction begins with Delorme and Flückiger, who, in a book about perception and reality, wrote a chapter on the perception of gestures (movements). They explain that the human visual perception system is able to distinguish very specific hand movements. Its ability to detect movement patterns is so developed that it enables us to know, when someone picks up a cup off the table, if they are picking up the cup to drink it or to remove it from the table. The meaning given to the initial action of picking up the cup is in part made possible by our ability to detect subtle movement patterns in the arm and hand (Delorme and Flückiger, 2003).

4.1 Rhythm

Next, comes Benveniste, who also accepts the idea that specific characteristics of one gesture/movement allow us to distinguish it from another gesture, and that it is something that happens at the moment of perceiving the movement, and is directly correlated with perception. Yet he understands this concept of a distinct movement in a much broader sense, as he defines the notion of *rhythm*. Benveniste elaborates; *rhythm* is not only the arrangement that causes *form* (in this case the form of the movement) to be distinguishable, but also the distinct arrangement of that which moves. (Bourassa, 2011)

To clarify his understanding of *rhythm*, Émile Benveniste goes back to its etymological Greek origins: *rhuthmos*. The etymological memory of *rhuthmos* (*rhéin* and *–thmos)*, defined here by Benveniste, invites us to think of rhythm as the production of a "*form*"/shape. This inseparable relation between *rhuthmos* and the emergence of a shape allows us to understand the production of rhythm and the production of meaning as one and the same action. (Bourassa, 2011)

Benveniste explains that the *form* is produced as "it is presented to the eye", as seeing a dance in its development, which explains how he understands *shape* as something that is relatively abstract: *-thmos*. Equally as important for Benveniste, is the etymology of *rhéin,* which differentiate *rhuthmos* from *schema, skhèma, morphè, eidos* from the fact that it's not a fixed shape. It rather references the mobility of something that changes over time. For Benveniste, rhythm is also not strictly related to a specific cadence in relation to time. As Garelli and Meschonnic (in poems) and Souris (in music) explain, rhythm is not that which is associated with the time increments of a clock. It is related to the dynamic relationship between elements that give a performance its unique *configuration*. (Bourassa, 2011)

Benveniste does not consider *rhythm* as a subcategory of the *form*, rather the organisation (*disposition*, configuration) of a whole (Kouadio, 2010). For example, if rhythm is in language, in a discourse, it is the organization (disposition, configuration) of the discourse. Kouadio further explains that since the discourse is inseparable from its meaning, then the rhythm is inseparable from the meaning of the discourse. The rhythm is the organisation of the meaning in the discourse. If it is the organization of the meaning, it is not a separate layer of meaning juxtaposed to the discourse, since the meaning of the discourse is made by all the elements of the discourse.

Beneviste's approach makes us understand rhythm as "a structure", which is the organisation of meaning in a discourse. This structure contributes in an important way to the various forms of signification of a poetic discourse. In the next section, section 4.2, we see how the "structure" of this discourse forms the singularity of a poetic discourse.

Jean Gagnon summarizes this concept by defining *rhythm* as what defines the singularity of a poetic discourse (in this study the poetic discourse is the musical performance) and as a participant of what produces the performance's meaning. (Gagnon, 2011, p.190).

The WOBL, which affects the rhythm of the artist's gestures and the sound produced, thereby also produces the performance's meaning.

This concept was explored in my discussions with Mason Bretan, who worked on *Shimon,* an improvising robotic marimba player, developed by the *Robotics Musicianship Group*, a group specialized in facilitating significant interactions between humans and robots at Georgia Institute of Technology.

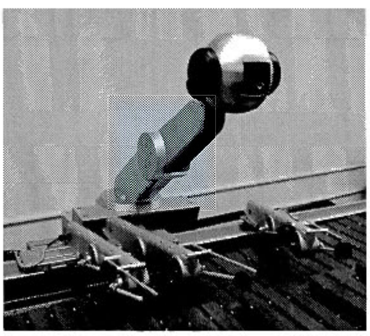


Figure 12: Photograph of the Shimon robot (left).
Figure 13: Photograph of the Shimon robot performing with Jade Simmons (right).

Bretan explained that one of the main differences between having an articulated robot play the marimba, in contrast to an array of aligned solenoids which hit the marimba notes, was that he had to consider the time it took for the arm of the robot to move from one note to the other. As such, the effective gestures of the robot and the melody played by the robot had a distinguishable *rhythm* that gave a unique meaning to performances produced by the Shimon robot.

As observed previously in Chapter 3, Guillaume's gestures when he played the keyboard, were different from his gestures when he played the WOBL, due to the WOBL's interface that affords more exaggerated effective gestures. The mechanical resistance that makes the WOBL's discs wobble back and forth also contributes to the *rhythm* of the generated sound. The *rhythm* of the gestures and sound produced when performing with the WOBL, consequently tint what is expressed by the performance and consequently the meaning associated by the audience to the performance.

4.2 Autopoiesis and Identity/Singularity

The *rhythm* of the gestures has a specific tint to it. It's possible to identify it. This has a lot to do with the fact that this *rhythm*, as I explained in Chapter 1, is caused by the undisputable interaction or feedback loop that exists between the *instrumentalist* and the instrument. Humberto R. Maturana and Francisco J. Varela (1928) help me explain how this *auto-creation* between the *instrumentalist* and the instrument define the structure and organization of a WOBL performance, and consequently its identity or singularity.

If the performance is viewed as a structural link between the *instrumentalist* and the *instrument*, both these elements, including all their properties, interplay between each other to form a unit. The organization of the unit is defined by the interactions between its components. This organization is what specifies the class identity of the unit/system. The structure of the unit can undergo changes, but the organization must remain invariant (as defined by Gibson, 1986) for the class identity of the system to remain invariant. In the case of a WOBL performance, the interplay that exists between the player and the WOBL defines the organization of this body-instrument system. The circular interaction between these components through gesture input, haptic and audio feedback, and cognitive interpretation, generate a unique WOBL *autopoiesis*, the action of producing and maintaining a specific organization. The properties of these components (the WOBL and the WOBL player) mold the invariant organisation of a WOBL performance and consequently the class identity of this system. We can then make cross-references between systems that have similar organisations. For example, the guitar has specific properties that give a guitar performance its specific identity. Thus, the structure of someone mimicking playing the guitar has organizational invariances compared to someone actually playing the guitar.

Ultimately, understanding the singularity of a system through its organizational invariances enables us to see how defining the interactive properties of an instrument facilitates an audience's ability to make meaningful relationships to past experiences by association with performances that include the same instrument.

In the following three section of this chapter, I will elaborate on the interactions between the *instrumentalist* and the instrument to illustrate how these interactions create an expressive discourse.

4.3 Experience

Gestures produced by the WOBL are also defined by the musical artist's understanding of the instrument. The artist is able to understand from the WOBL that there exists a link between the effort he inputs with his hands, the tension he feels in the disks, and the sound produced. Consequently, the kinaesthetic tension and the sound heard are both feedbacks that provide input to the gestures that the artist makes. Inadvertently, the artist will adapt his gestures according to the sound he hears, as observed in Section *3.3.3 Elaborate effective gestures*.

In his book *Meaning of Technology*, Arnold Pacey explains in his chapter *Meaning in the hands* how detecting specific patterns through "the eyes and hands" without necessarily using specific data and information, enables such things as intuition and creativity.

Pacey gives examples, such as how mechanics were able to have hunches on the state of a machine by the sound it produces without necessarily understanding its inner workings; or how a craftsman is able to work well with his tools only after he understands the necessary tension needed to be applied in order to use his tools properly, and he will adjust his movement until he feels it produces the right finish.

Acoustic musical instruments have a degree of transparency transmitted through the senses. It is by relying on these sensations that musicians are able to recognize if they are plucking the strings on a guitar correctly, or if they are blowing into a trumpet in the right way. This feedback enables the education of the musician artist.

Pacey explains how it is through the *feeling* of the instrument that gaining experience is possible. He illustrates this by explaining how a runner adjusts his movement until he feels the movement of his legs and arms are perfect. The experience of an athlete evolves as he perfects this movement. This is only possible by relying on the sensation of his movement in order to judge if the movement is being done correctly or needs to be adjusted.

In the case of the WOBL, the transparent causal relationship between the artist's gestures and the sound generated directly defines the artist's tacit understanding of the instrument. As the *instrumentalist* relies on this understanding to produce the desired sound, he develops an intuitive knowledge of how to manipulate the instrument and develops specific gestures in order to make the desired sounds. These gestures then become part of the expressive qualities of a performance, for they express, as mentioned earlier "information about performer expertise" (Bardy, 2009).

4.4 Embodiment

It is important to note that without voluntarily desiring to create a haptic digital musical instrument interface, it accidently happened as a consequence of deliberately attempting to convey the idea that a gesture was related to the sound heard. This *serendipitous finding* has other repercussions in the expressive nature of the performance with such an instrument, from the embodied experience provided by the kinaesthetic feedback of this instrument.

According to the Stanford Encyclopedia of Philosophy, the thesis of embodied cognition is the following:

> **Embodiment Thesis:** Many features of cognition are embodied in that they are deeply dependent upon characteristics of the physical body of an agent, such that the agent's beyond-the-brain body plays a significant

> causal role, or a physically constitutive role, in that agent's cognitive processing. (Wilson and Foglia, 2011)

To illustrate this thesis, a good example would be that of a person picking up a cup.

> [...] when we observe a person grasping a cup of coffee, the very same neural population that controls the execution of the grasping movement becomes active in the observer's motor areas. (Wilson and Foglia, 2011)

This limited and simple example serves to illustrate how the body has an important part in our cognition. As the above example shows, the grasping action is so important for our body's survival, that when we see and recognize this movement in others, it activates the very same neurons in our brain that are associated with the execution of this action ourselves.

Physical haptic interfaces help this embodied cognition, because they link certain outcomes to a distinct physical movement or physical space.

It has been shown that people with highly advanced motor skills who are expert at playing their acoustic musical instruments, emphasized the importance of physical control and the use of their body as an important factor in making music (Magnusson and Hurtado, 2008) This was observed in Chapter 3, in Section *3.3.3 Elaborate effective gestures*, when I described how access to a specific melodic effect producible with the WOBL was only possible through a specific complex effective gesture.

Nijs (2010) explains how the embodied experience that is rooted within an optimal relationship between the musician and his musical instrument is considered a necessary condition for a flexible and spontaneous expression of artistic ideas, or in other words *improvisation*. Justly so, Magnusson and Hurtado's (2008) survey explains how "improvisation with acoustic instruments, on the other hand, can be fast, unpredictable and highly varied in form, even within the same piece/performance. The desire is now for digital instruments that have expressive depth, ease of use, and intuitive flexibility."

Nevertheless, interfaces that facilitate the process of embodied cognition have a great effect on the manner in which, in this case, an instrument is played. In summary, not only do the gestural interface of the WOBL and the embodied experience it provides affect how it is played, but also what is played. This inevitably affects the expressive qualities of the artist's performance, whether these are the gestures, the audio-visual content, or the *rhythm* as a whole.

4.5 Mirror Neurons

The expressive nature of gestures and music has strong emotional effects. Mirror neurons play an important part in enabling us to see a person's intention (Iacoboni, 2005) and are commonly thought to be linked to empathy (Hunter, 2009).

In his research, Hunter expresses how *rhythmic-modal experiences*, *synchronous group activities* or *cooperative movement* provoke a very strong emotional state. This is why activities such as playing in a musical group, form tight bonds between the members of the band. As Seth Hunter explains:

> *Synchronous Movement* as one neuroscientist put it, is "*the biotechnology of group formation*" (Haidt et al. 2008). He argues that moving in time together is pleasant for us now (in part) because ancient people who had a heritable tendency to enjoy synchronized movement were more likely to participate in such activities, reap the benefits of closer social ties, and leave more surviving offspring than those who did not (Hunter, 2009).

Seth Hunter, a fourth year PhD student in the Fluid Interfaces group at the MIT media lab, based his Creation-Research Project, *Harmonia*, on this principal. Harmonia is a digital musical instrument composed of two separate parts, played by two different artists. Each part of the instrument generates both audio and visual haptic feedback signals, which are heard and seen by both participating artists. Depending on the level of synchronicity achieved by the artists simultaneously manipulating their part of the instrument, a specific combination of audio and visual feedback signals is emitted, indicating both to the artists and the audience that the audio and visual signals are synchronized (or not).

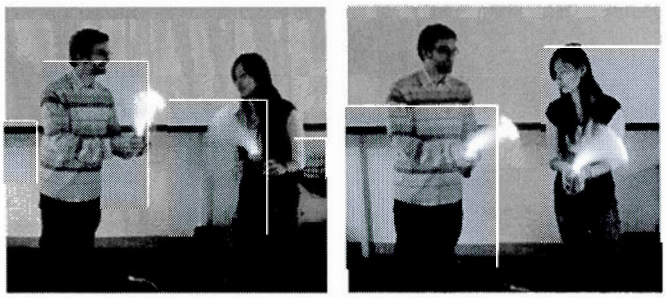


figure 8. Two participants, out of synch (left) and in synch (right).

Figure 14: Two participating artists manipulating the Harmonia.

As with the Harmonia instrument, the WOBL artist's unique exaggerated gestures enable the other members of the band to experience temporal synchronicity with these gestures. These gestures are part of the WOBL performance visual output signals that communicate to the audience the intention of the musician, which may provoke an empathetic emotion by the audience for the performer.

Mirror neurons don't only convey emotion through or in response to visual gestures. Research shows how sound directly related to gestures and the performer's intention play a great role in conveying emotion through mirror neurons. Expressive changes in tempo (rubato) or sound level (dynamics) are "parameters that are manipulated through emotionally charged movement, [...] two properties of music that may convey emotion from performer to listener through a process of motor resonance" (Heather, 2010). This study further suggests that:

> [...] Perception of motion in music [71] may occur through activation of mirror neuron and motor systems and lead to emotional responses through interactions of the mirror neuron network and limbic system taking place via the insula [70]. In conjunction with the observation of motor networks involved in pulse perception, the current observations suggest the possibility that listeners perceive motion in the dynamic fluctuations of music performance, and this results in a form of empathic motor resonance leading to emotional responses [69]. (Heather, 2010)

By mapping the amplitude of the emitted sound to the WOBL's moving disks' rotation speeds and the amplitude of the movement of each WOBL disc, the instrument can be used to explore the emotional relationship between the intention of the WOBL performer and what the audience perceives while hearing and seeing the WOBL performance.

CHAPTER 5
DEFINING A MUSICAL INSTRUMENT

A particular consequence of transferring specific qualities of an acoustical musical instrument, such as a guitar, piano, harmonica, to the world of digital computers, with music sequencer software and synthesizers, is that the definition of what a musical instrument is becomes blurry. The line between these two becomes foggier if we attempt to see how an audience viewing a WOBL performance conceptualizes the instrument.

5.1 A Technical Definition

Let's begin with a technical definition. Marcelo M. Wanderley defines the term digital musical instrument (DMI) as follows:

> *A digital musical instrument* (DMI) is used to represent an instrument that contains a separate gestural interface (or gestural controller unit) from a sound generation unit. Both units are independent and related by mapping strategies.
> The term *gestural controller* can be defined here as the input part of the DMI, where physical interaction with the player takes place.
> Conversely, the *sound generation unit* can be seen as the synthesis algorithm and its controls.
> The *mapping layer* refers to the liaison strategies between the outputs of the gestural controller and the input controls of the synthesis algorithm.
> This *gestural interface separation* is impossible in the case of traditional acoustic instruments, where the gestural interface is also part of the sound production unit. (Wanderley, 2002)

It is clear according to this definition that the WOBL is a *gestural controller*, because it is "where the physical interaction" takes place. The computer mapped to the WOBL interface is the *sound generation unit*.

In addition to the segmentation of DMIs, Wanderley (2002) proposes three sub-categories for controller designs.

> □ *Instrument-like controllers*, where the input device design tends to reproduce each feature of an existing (acoustic) instrument in detail. Many examples can be cited, such as electronic keyboards, guitars, saxophones, marimbas, and so on.
> □ *Augmented Instruments*, also called *Hybrid Controllers*, are instruments augmented by the addition of extra sensors.
> □ *Alternate controllers*, whose design does not follow that of an established instrument. Some examples include the Hands [97], graphic drawing tablets, etc.

According to this definition, the WOBL would be classified as an *alternate gestural controller*.

5.2 A Composed Instrument

Similar to Wanderley, Schnell and Battier point out that "the concept of a *composed instrument* became possible when musical instruments became dematerialised. In other words, with electronic technology, it was possible to conceive a sound producing device independently from its gestural interface". Schnell and Battier explain that a *composed instrument* is made of two main components: a sound producing part and the gestural performance part decoupled from one another, much like Wanderley's definition of a DMI.

Schnell and Battier prefer the use of the term *composed instrument* (different from Wanderley's definition of DMI), because it "underlines the fact that the computer systems used in a musical performance carry as much the notion of an instrument as that of a score, in the sense of determining various aspects of a musical work." This is similar to Jean Gagnon's intention behind his concept of the *composition of an* *instrument*, which affects the *rhythm* and expressive nature of a performance. With this definition it's possible to say that the WOBL is a composed instrument for it has, as discussed in section 4.1 and section 4.5, a specific composed *rhythm* or *structure* related to the instrument's design.

5.3 A Phenomenological Metaphor

In the attempt to define the WOBL, it may be important to remember that the focus of this research is on the "*unsatisfied feeling* that the audience of computer music performances tends to have, due to the lack of perceptual causality between the body gestures of the musician(s) and the resulting sound" (Magnusson and Hurtado, 2008).

If we focus on this important role or purpose of instruments as part of a live performance, a wide variety of DMIs do not fulfill their purpose in a live performance, despite the presence of the gestural controller unit. Is it possible to say that DMIs aren't musical instruments for they are lacking an important characteristic of their counterpart, acoustical musical instruments?

Perhaps we are attempting, in this metaphorical definition, to impose a purpose on a DMI without it necessarily being an intrinsic part of the object. In fact, the intrinsic differences between DMIs and traditional acoustic instruments (Knapp and Cook, 2005) seem clear to all who define them, the decoupling of the sound-producing device from its gestural interface.

Perhaps there is no such a thing as a digital musical instrument, because the definition of a musical instrument is a combination of something that is intrinsically *the gestural controller* (the interface) and something that produces the sound (the sound generating unit), functioning together as one unit. Perhaps the concept of a digital musical instrument (which has these two elements decoupled) is simply used as a metaphor to explain the intended purpose of circuits, software and controllers (sensors). Norbert Schnell and Marc Battier explain that in fact the metaphor of *musical instruments* is "easily employed for a wide range of artistic performances with computers". Here we understand metaphor in the same way George Lakoff (2003) defines metaphors. It is not interpreted as "a device of the poetic imagination and the rhetorical flourish" (Lakoff, 2003) but rather as a *metaphorical concept* through which we understand and experience one kind of thing in terms of another.

As such it's difficult to classify the WOBL as a musical instrument, for it technically isn't. Yet, it attempts to communicate specific qualities of a musical instrument. It would be necessary, in further studies, to see if when observing the WOBL in a performance, the viewer conceptually understands the object as a music instrument or as a gestural controller.

CONCLUSION

As this is a Research-Creation project, I think that one of the things that oriented the production of this instrument was my background in communication and computer arts, rather than in engineering or in music.

It was through this perspective that I attempted to address Jean Gagnon's challenge regarding the reduction of character and expressivity of the artist's performance when using digital musical instruments. To address Gagnon's challenge, I felt that an important characteristic of the instrument was that the instrument had to clearly express the causal relationship between the gestures of the artist playing the instrument and the sound produced by the instrument. To do so, I created the WOBL, whose interface design and the mapping of the sound synthesis exaggerates the *instrumentalist's* gestures. In fact, I observed three distinguishable types of gestures produced when Guillaume Dubois and I used the WOBL: accompanist gestures, effective gestures and a variation of the latter elaborate effective gestures.

I deduce from observing these gestures and by comparing the WOBL's characteristics with other research in the field that the design ideas present in the WOBL affects the expressive qualities of a digital musical performance. Even though we can say the WOBL does express concepts that would not have been expressed otherwise, it fails to answer how this is interpreted by the audience. In fact, we could say the WOBL communicates simply because it exists as far as this research goes, without necessarily knowing what it communicates. In fact this is one of the reasons I attempt to define the WOBL technically, artistically and metaphorically. Further research would be able to shed some light on how a performance with this instrument is interpreted.

Personally, in retrospect, I realized that I focused mainly on the instrument and the expressive qualities it can produce, yet forgot about the two other elements in Gagnon's performance triad, the *instrumentalist* and the *content*. The *instrumentalist* is a main source of variability in any type of interactive activity. This provides a great deal of depth to the expressive outcome of any interactive project. Equally as important, is the concept of time, through which the *content* needs take form. Both these concepts brought my attention to two important concepts in interactive media, that of chaos (variability) and time.

ANNEX A

Identification du projet
Titre du projet: Le Wobble
Type de médium: Média interactif, tinkering, menuiserie

Identification du requérant
Nom et prénom: Borrero Luz, Leonardo
Adresse: 3952, av. Van Horne
Ville: Montréal
Code Postal: H3S 1S1
Numéro de téléphone: 514 660-1313
Courriel: leonardo_borrero_luz@live.com
Code permanent: BORL23078608
Programme d'étude: Communication Médias Interactifs
Année complétée dans ce programme: 3

Prélude

Le mécanisme décrit ci-dessous permet la création d'une nouvelle interface de contrôle et conséquemment un nouvel instrument de musique numérique.

Mécanisme des disques du wobble

Le mécanisme soumis au brevet sera décrit en deux parties. La première partie énumère les diverses composantes nécessaires pour créer un wobble. La deuxième partie fait l'explication du fonctionnement ainsi que met en valeur la raison de chacune des parties.

L'objet en soit peut être considéré comme innovateur par son propos. Tout de même, c'est le mécanisme qui importe dans cette déclaration d'invention. Le mécanisme qui sera décrit ici fut inventé pour remplir des besoins amenés par le concepteur du wobble. Cela est dit pour montrer à quel point ce mécanisme est intrinsèquement lié à ce nouvel instrument de musique.

Un wobble est composé de cinq disques alignés par un axe de rotation soutenu par une base. La forme du wobble est celle semblable à un tam-tam 32 pouces de hauteur et 8 pouces de diamètre à sa section le plus large. Chaque disque du wobble est composé d'un disque rotatif(19) et une tête de lecture(18) qui sont chacun composés de divers éléments.

Tous les morceaux du disque rotatif(19) s'appuient sur le disque de support(8). Sur ce disque, il s'attache; un palier à bille(7), quatre pièces de fixation pour le palier à billes(6) et quatre vis correspondantes, une piste résistante(4b) qui se trouve sur la partie supérieure du disque de support(8), deux vis pour attacher les élastiques(2a) ainsi que la surface d'interaction du disque rotatif(9). Ces pièces bougent ensemble pour composer le disque rotatif(19). Le disque rotatif(19) est maintenu en place sur l'axe principal(10) par deux anneaux élastiques/C-clip(5).

La tête de lecture(18) est composée d'un curseur(4a), de la plaquette de support à position fixe(3) et de deux autres vis pour attacher les élastiques(2b). Cette pièce est placée en haut du disque rotatif(18) pour que le curseur(4a) s'accote sur la piste résistante (4b). Les deux éléments précédents mis ensemble créeront la résistance variable.

Deux élastiques(1) relient la tête de lecture(18) au disque rotatif(19). Une extrémité de chaque élastique est placée à proximité de l'axe principal(10), sur la tête de lecture(18), et l'autre extrémité de chaque élastique est attachée à un point retrouvé proche de la circonférence des disques de support(8).

Comme mentionnée, la création de ce mécanisme essaye de répondre aux demandes du concepteur du wobble. Une requête importante du concepteur fut que la rotation des disques se fasse avec peu de friction, d'où la raison pourquoi un palier à billes a été utilisé. Par contre, le diamètre extérieur de chaque disque varie entre 5 et 8 pouces de diamètre avec un diamètre intérieur de 9mm. Aucun manufacturier ou distributeur de palier à Montréal n'a des paliers avec un diamètre intérieur de 9mm et un diamètre extérieur de 8 pouces avec une hauteur de 0.28 pouce à l'intérieur et une hauteur de 1 pouce à l'extérieur.

Il n'existait pas non plus de potentiomètres sans friction à l'axe. Normalement un potentiomètre doit avoir de la friction pour que le potentiomètre reste à la position dernièrement choisie par l'usagé. En règle générale, les potentiomètres utilisent une colle spéciale pour offrir les propriétés distinctes d'utilisation des potentiomètres. Du côté du wobble, des élastiques sont utilisés pour créer cette tension. Ceci est un des éléments innovateurs de l'invention. Ceci permet deux choses très importantes à la distinction du wobble. La première c'est que les disques du wobble reviennent toujours reprendre leur position initiale précédée d'un graduel va-et-vient. Deuxièmement, le va-et-vient est semblable à un pendule avec une même fréquence et variation en amplitude qu'un ballon qui rebondit. C'est la tension et l'élasticité des deux élastiques qui permettent d'avoir le résultat désiré aux niveaux de l'interaction et au niveau des données générées.

Transformation du signal électrique

Chaque disque a son propre signal électrique. Chacun de ces signaux électriques varie lorsqu'un des disques est déplacé. Les résistances variables de chaque disque permettent de capter la position de rotation des disques. Ces données sont par la suite reçues par l'Arduino(17) à la base du wobble.

L'Arduino reçoit les données, les transforme et les envoie à l'ordinateur en sérail. Le logiciel TataOSC (développé par Thomas Ouellet Frédericks, chargé de cours à l'École des médias de l'UQAM) transforme le signal du Arduino vers un signal qui varie de 0 à 1024. Le logiciel MaxMSP est utilisé ensuite pour modifier le signal généré par TataOSC pour le rendre significatif et utilisable par les musiciens. Voici la transformation:

Les élastiques maintiennent les disques dans une position centrée. Ceci est la position en repos du disque. Au repos, la donnée reçue est de 512 étant donné que le signal varie de 0 à 1024. L'indice de lecture au repos est transformé à 0 et s'appelle dans ce document l'origine.

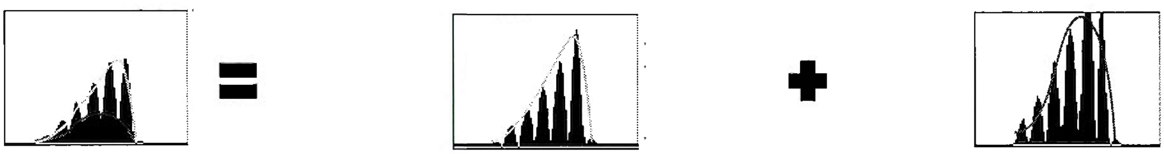
ORIGINE = INDICE DE LECTURE EN POSITION DE REPOS

Une fois l'origine définie, il est possible de calculer la distance de rotation lorsqu'un disque est pivoté. Cette distance représente l'amplitude de rotation.

AMPLITUDE DE ROTATION = ABS (ORIGIN - INDICE DE LECTURE)

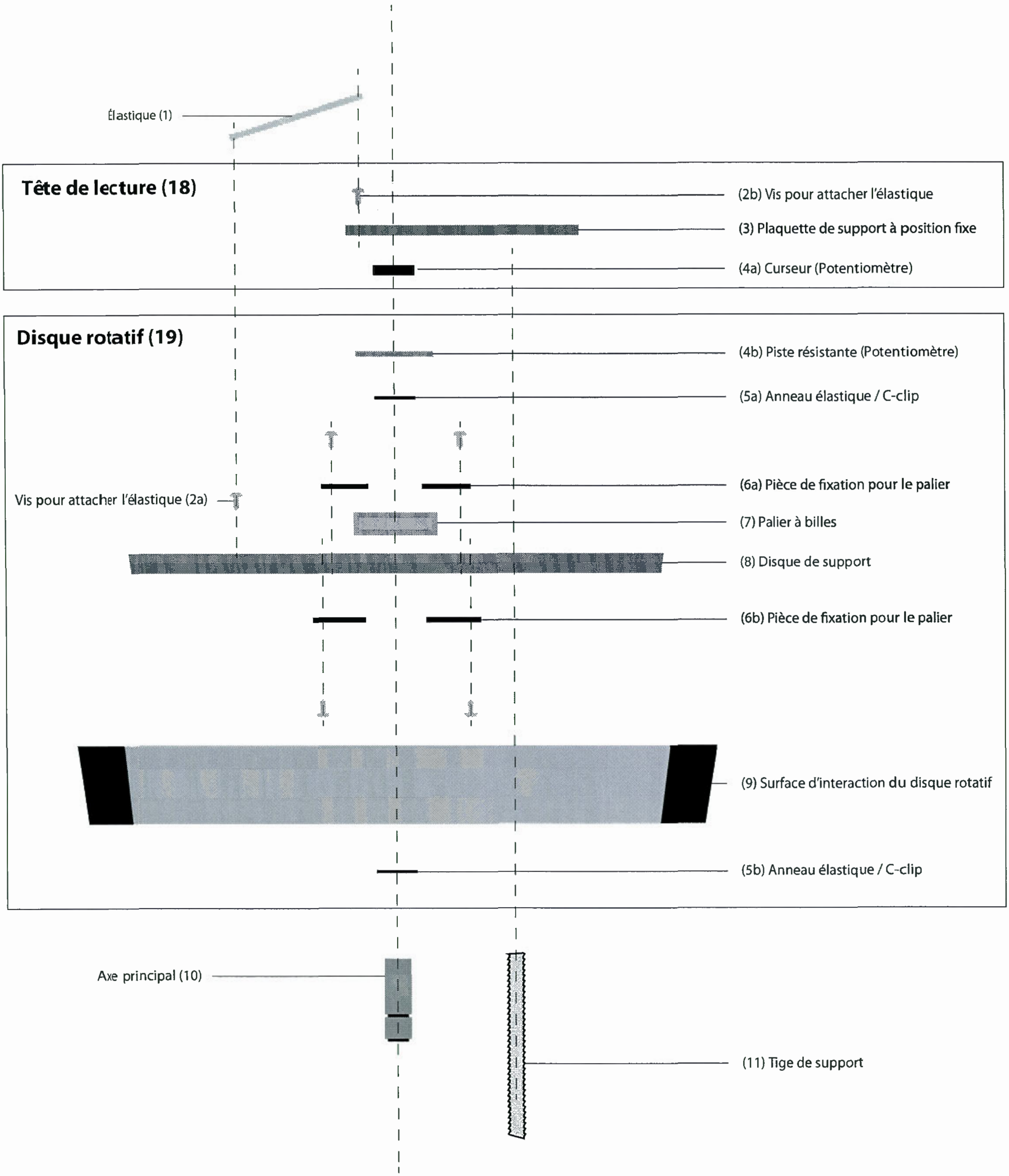
La vitesse de rotation rentre également en compte pour produire une sortie de données intéressantes.

DONNÉES = AMPLITUDE DE ROTATION*0.6 + VITESSE DE ROTATION*0.3

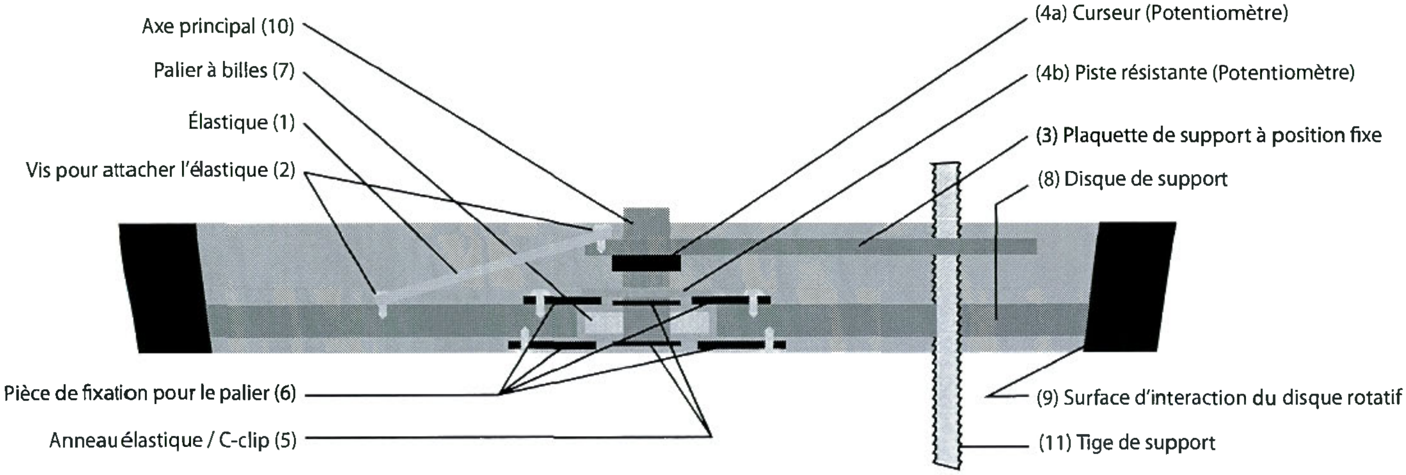


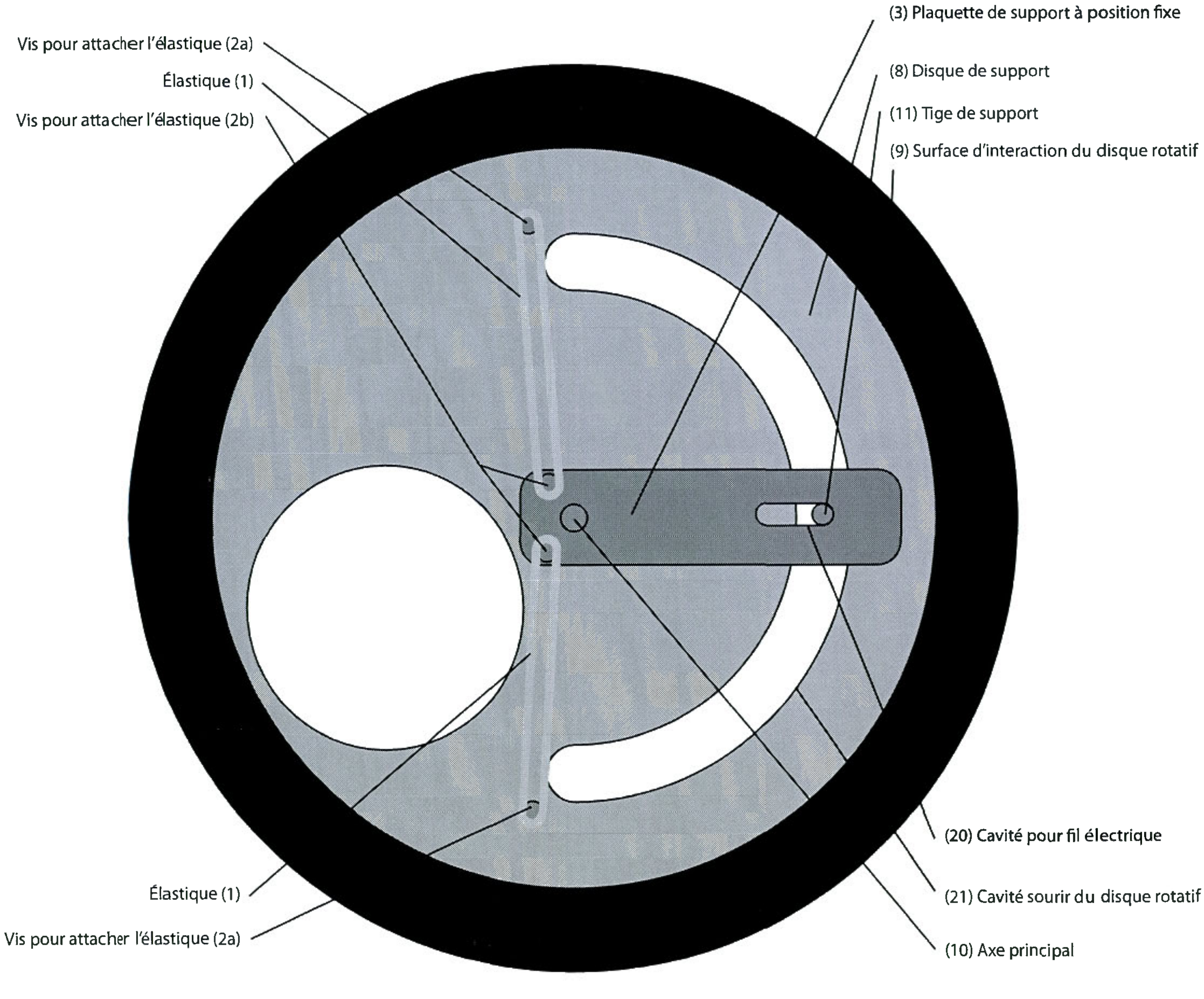
Cette manipulation permet de générer un flux de données uniques, car elles sont intrinsèquement liées au mécanisme de cet instrument.

Disque du wobble

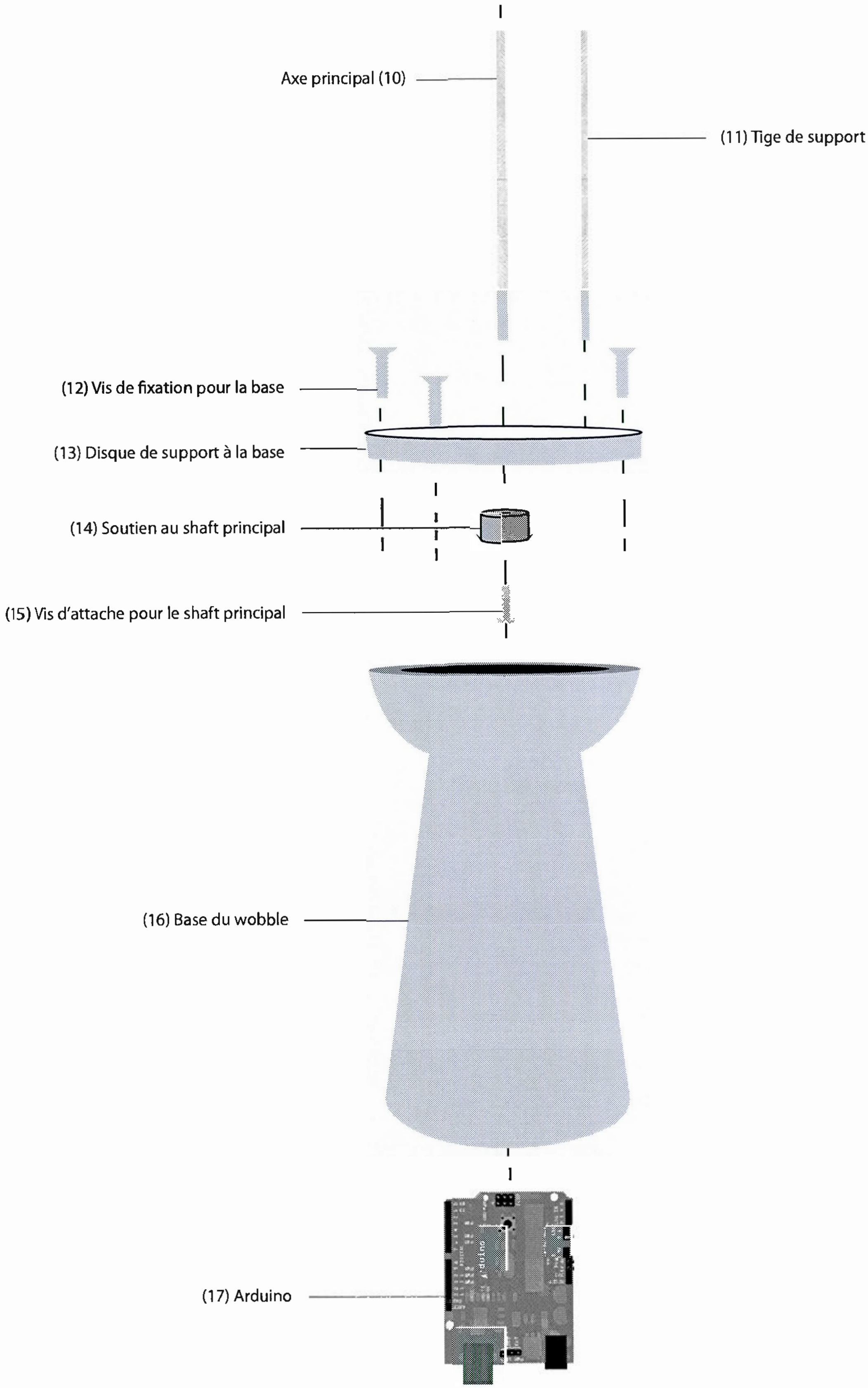


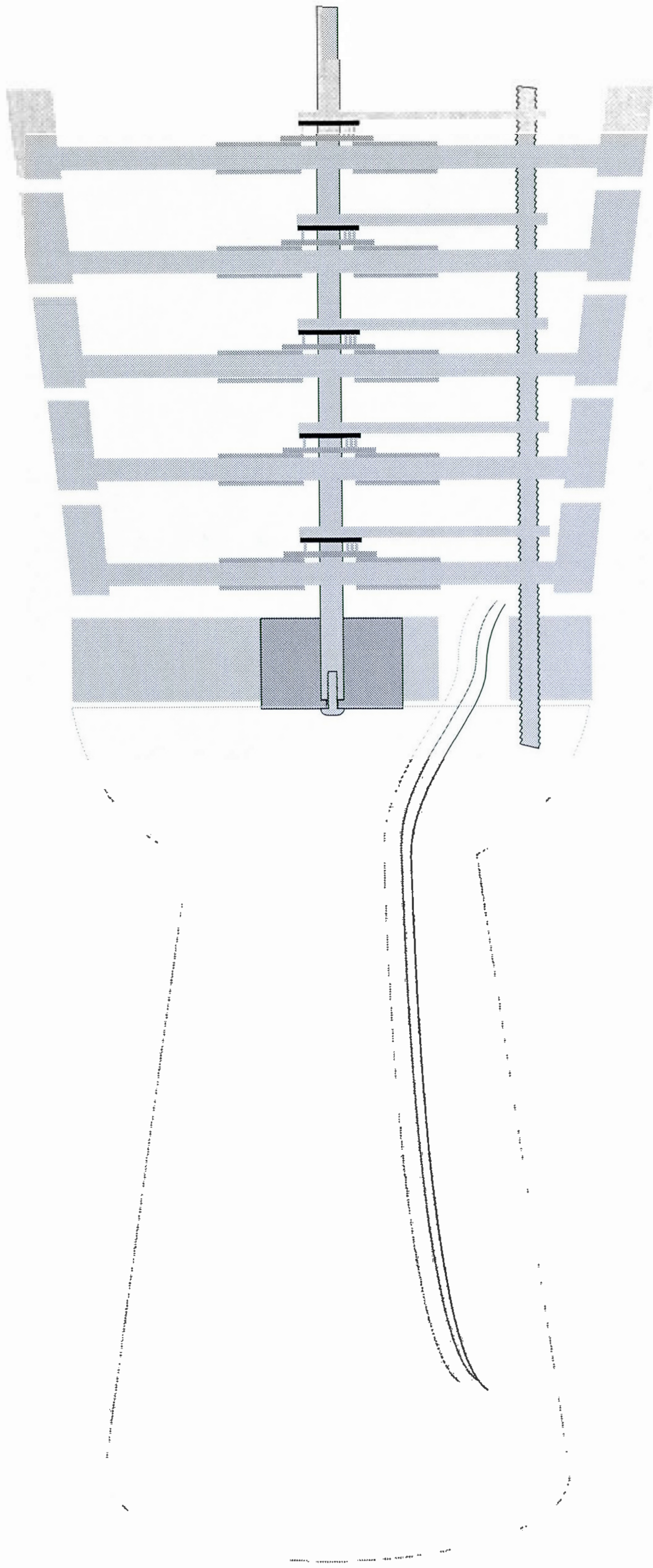
Disque du wobble





Base du wobble





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