

# A Multimodal Interactive Installation for Collaborative Music Making: From Preservation to Enhanced User Design

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## ABSTRACT

Interactive installations are complex cultural objects. They can be examined from different perspectives, some of which show interesting overlaps. This study approaches a multimodal interactive installation for collaborative music making called BilliArT from the viewpoints of conservation, aesthetic experience and artistic design. The long-term goal is to achieve a better understanding of how people engage with interactive installations, and ultimately derive an ontology for interactive art – that can be usefully used by art historians/critics, conservators and artists. This article presents preliminary results on the users' rating of their experience with the installation, and on the effect on mood.

## I. INTRODUCTION

Recent technological evolution has produced a large variety of tools in the area of "multimedia". Capturing, tracking and recording devices; software to process, manipulate and store single files or large projects; have had a great impact on our environment thanks to their low access threshold (they are available, affordable and novice user friendly). As it is often the case with emerging technologies, multimedia has appealed artists and creative people, who have largely explored its expressive potential, and have successfully integrated its language in their practice.

Installations are complex objects. They present complexity at a technological level, raising questions about their survival over time, due to failure and obsolescence of the components, but also to the lack of a standard notation to represent their assemblage and the dynamic interaction of the parts. And they present complexity at cultural level, because they elude closed definitions and resist categorisation (the all-inclusive class of "installations" is not very useful to any further degree of analysis and discussion), and they address the public in ways that are often substantially different than that of "traditional" art forms: site specificity, dynamicity, interaction, are not just "flavours" added to an installation, they are structural elements in the expressive language. Capturing, describing, understanding and preserving installation art is therefore an open problem, where urgency is a pressing factor considering the short life expectancy of installations (Bressan et al. 2017).

We move from the assumption that in the rich and diversified landscape of studies around artistic installations, some approaches to the observation and analysis of the installation can overlap across critical and conservative aims – as well as artistic aims. In particular, there is a lot of space for novel systematic exploration around interactive installations, and it is our opinion that, at this stage, for example questions asked by an artist to improve his own work can trigger a new idea in the process of conservation. This is especially true for two aspects of interactive installations that are not fully

understood yet – unlike the description and archiving of the installations as "objects" per se, which is being successfully done by museums and conservation institutes. These two aspects are: interaction and the user's experience. This study follows the line of other studies in the music field, where music-based interaction is currently being addressed from a wide range of perspectives, in relation to expression, gestures and social and cultural contexts. It is an exploratory study where different methods are used to analyse an installation, trying to answer questions about its conservation, the nature of the user's experience, and the artistic design.

The long-term goal is to achieve a better understanding of how people engage with interactive installations, and ultimately derive an ontology for interactive art – that can be equally used (agreed upon, understood and usefully applied) by art historians/critics, conservators and artists. This article presents a set of results from an explorative study conducted on a real life installation called BilliArT. BilliArT is a dynamic system in which generative music emerges from the interaction of the participants with a standard carom billiard table. The installation was first presented to the public in 2013 and it was re-installed in a laboratory setting in 2015 for this experiment. A large set of data has been collected and processed: in this article, we present two preliminary results, about the users rating of their experience with BilliArT, and about the effect of BilliArT on mood. Section 2 describes the installation and the technical setup. Section 3 describes the experiment and the data.

## II. BILLIART

BilliArT is a dynamic system in which generative music emerges from the interaction of the participants with a standard carom billiard table. It was developed by Tim Vets at Ghent University, and first presented to the public in 2013 (Saenen et al. 2014). The installation features a jazz-inspired "algomorphic" approach to real-time music composition, combining sampled traditional jazz instruments (guitar, bass, drums) with their electronically manipulated counterparts. BilliArT presents the user with an interface that is familiar to most people, a billiard table: no musical training is required to make music with BilliArT, as the composition unfolds as the game of billiards evolves. However, standard billiard rules don't need to be respected, both to eliminate the requirement of having to know the rules, and to allow a greater degree of freedom in the exploration of sounds (for example the players can manipulate the balls with their hands, block their free roll or redirect them – but they cannot lift them from the table or remove them from the playing area). There is no standard playing duration and one or more people can play together. In this study, though, we experimented with a single-user interaction (Fig. 1).

The installation represents a unique case study for scientific investigation because it was specifically designed to be an artistic work as well as a *measuring tool*. It is a broad idea, but practically it means that the installation allows for an experimental setup to be built around it, by fulfilling a list of requirements: for example, the size of the system must fit in the lab; the duration of the interaction must allow observation without being hours long, and of course the laboratory paraphernalia must not interfere with the artistic experience of the system. In this sense, the close collaboration of the artist has been valuable and necessary. Nobody else can have the authority to judge about the impact that a small decision can have on the desired effect of the installation – unless mandated by the artist himself. Getting the artists personally involved is generally a great asset to the project (Guggenheim 2003), but it's not always possible (for reasons including geographical distance, overbooking, unavailability, lack of interest, untimely passing, etc.). In our case, not only did the artist participate in the experimental design, but helped with the planning of the data collection and analysis thanks to his in-depth knowledge of the technical setup of the installation. For a detailed description of the technical setup, see Vets et al. 2017; in the next Section we present a concise description of how the installation works.

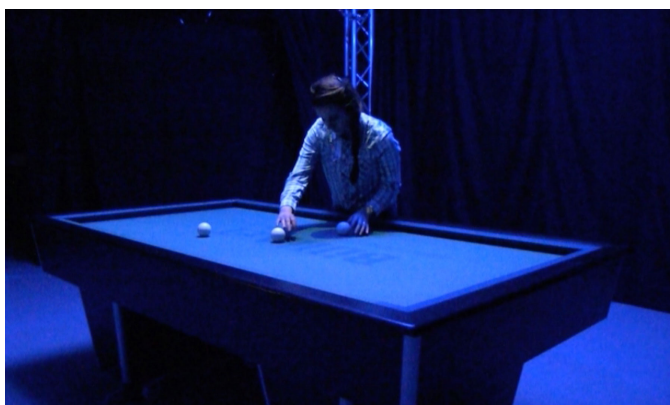


Fig. 1. Participant interacting with BilliArT.

### III. EXPERIMENTAL

With this experiment we aimed to explore different aspects of the installation. The spectrum of questions that can be asked is unlimited, and sometimes very interesting input comes from questions that artists ask about their work, which – just like scientific questions – may necessitate systematic observation and sophisticated answers. For example, when a new work is ready, the artist is normally interested in the public's reaction because it is revealing of the effectiveness of his concept: “we could compare an artist with a scientist who is testing a certain hypothesis” (Reber 2008). The artist wants “to verify end-user acceptance and overall system [effectiveness] and to get feedback to inform future design” (Abowd & Mynatt 2000), which is the same approach used in the evaluation of interactive systems (a well developed field in engineering, for example (Bellotti et al. 2013)).

In the case of BilliArT, the system is “dormant” until a user interacts with it by moving one of the three balls available on the table. The balls movement is tracked by a motion capture system and translated to sound. The mapping with which this

occurs is not straightforward and (intentionally) difficult for the user to figure out. Parameters like the balls speed and direction contribute to the production of the sound, which can be perceptually described as a continuous *texture* (Vets et al. 2017) of guitar and percussive sounds.

Each player had one minute time to familiarise with the system, and then they proceeded with a playing session (real-time composition) without any time limit. The data that have been collected include:

- **Video recording:** each game was recorded with two fixed cameras: one on the side of the table, in the corner of the room, and one facing down from the ceiling, above the centre of the billiard table, to capture the balls movements.
- **Audio recording:** the sonic output (the musical composition) was recorded directly from the line-out of the sound card mixing and redirecting the pre-recorded samples and the synthesised sounds to the speakers; the audio is also contained in the side video recording, providing an additional audio cue to align the video with the high-quality audio, besides the visual cue of the balls movement.
- **Motion capture data log:** the data log from the motion capture system was saved for each game, allowing for quantitative analyses on the games attributes such as exact duration and Quantity of Motion (Bressan et al. 2018);
- **Questionnaire:** a semi-structured anonymous questionnaire requiring the participants to fill in some question right before and some questions right after the playing session;
- **Interview:** a semi-structured interview was carried out (and audio-recorded) right after the playing session.

There was some intentional redundancy in the data, aimed at integrating eventual missing data (which was not necessary) and at the verification of the consistency of the data. For example, the balls trajectories were graphically reconstructed starting from the motion capture data log (Fig. 2) and superimposed to the video recording captured from the top of the table (to see how much noise was recorded by the motion capture system in the trajectories of the balls).

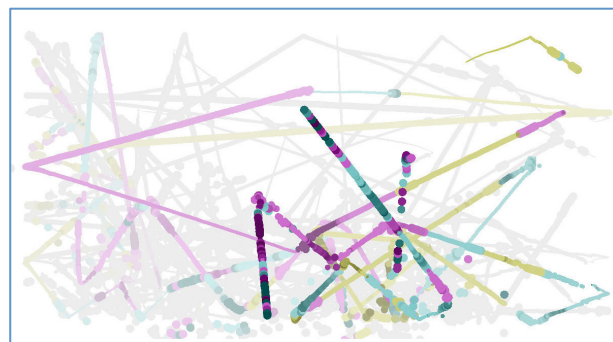


Fig. 2. Graphical reconstruction of the balls trajectories using the motion capture data log.

#### A. Familiarity with Interactive Installation Art

The questionnaire was designed to cover the three areas of conservation, user experience and artistic design (detailed

description in Bressan et al. 2018). In the section for the general profiling of the participants (filled in before the game), we asked them to indicate whether they had previously had any experience with other interactive installations. In a binary quantisation, the answers “Yes, a little” and “Yes, quite a bit” were considered positive, “No, never” negative. Then, in the second part of the questionnaire (filled in after the game), the participants were asked to rate (on a scale from 1 to 7) pairs of opposite adjectives about aesthetic characteristics of the installation and their effect on the enjoyability of their experience with it. One of these pairs was “boring / exciting” (where 1 is “boring” and 7 is “exciting”). The data plotted in the bar chart (Fig. 3) combines these answers and tries to answer to the following question: “Do previous experiences interacting with artistic installations influence how boring or exciting the experience with BilliArT is perceived?”. Is there something specific about interacting with an artistic installation that makes the excitement of engaging with them increase over time? Is engaging with art a specific type of experience (intellectual, aesthetic) where knowledge is formed or skills developed? And therefore: are specific requirements needed to make the most of the experience with an artistic installation? Of course crossing these data is not sufficient to give a solid answer, but looking into them is precisely the purpose of the exploratory study. Other answers in the questionnaire could expand the discussion on this issue, but the amount of data collected is so large and particularly diverse (audio, video, text, data logs), that cross-checking and mining it will be the work of the next year. The bar chart shows a clear tendency of participants to find their experience interacting with BilliArT more exciting if they have previously had experiences with other interactive installations. A small minority of participants who have had previous experiences said that their experience with BilliArT was “neutral”, and none found it “boring”. While even among participants who had never interacted with an installation before there is a preference for a positive evaluation. This suggests that there might be a connection between being familiar with the world of interactive installations art and the degree to which the interaction is enjoyable, but of course the quality of the design of the installation plays a role, so besides looking deeper into the other data in the questionnaire, we plan to replicate this experiment with installations other than BilliArT. And people who go out and visit art exhibitions might tend to score high in *openness* in a personality test (Chamorro et al. 2008), so a multidisciplinary approach involving psychology should probably be taken in serious consideration – for this question as well as the others relating to the user’s experience.

## B. Effect on Mood

Right before and right after the playing session, all participants were asked to express the mood they were in using one or two words, in an empty text field (no suggestions) in the questionnaire. Some answers include “sleepy”, “a bit tired”, “agitated”, “calm” and “quite happy”. Processing the answers, we noticed that many words used by the participants recurred in many answers, increasing the motivation for a

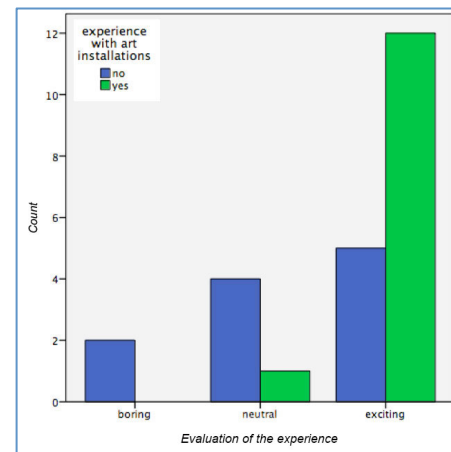


Fig. 3. Bar chart showing the participants’ rating of their experience with BilliArT.

visualisation in the form of a word cloud. We created two word clouds with all the words used by the participants to express their mood before the game, and after the game (Fig. 4). To do so, we first prepared a list of *content words* (in this case adjectives), discarding *function words* (including “a little bit”, “quite”, etc.); we also attributed an English translation to a Dutch term used by one of the participants (several Dutch native speakers, fluent in English, were consulted about this and there was 100% consensus on the choice, i.e. *geprikkel* was translated as “excited”, with a positive connotation). The total number of unique words used is 19; the most recurrent word is “tired” (8 occurrences). A handful of words were used only once, so there isn’t a “least” used word. Among the least recurring: “sick”, “playful”, “grumpy” and “vibrant”. The number of words can be greater than that of the participants because each participant can use more than one word to express how (s)he feels (expressions like “grumpy and a bit tired” will count as “grumpy” and “tired”). In this case it is lower (19) because many people shared the same words.

This analysis revealed a difference between males and females. Before proceeding, it should be mentioned that the questionnaire only offered two choices to the participants, namely “male” and “female”, and that the authors are planning, together with experts in gender policies and studies, to implement in the next experiments a choice that reflects the current trends in gender categorisation. And that the application of a *gender mainstreaming* policy (European Commission 2008) is an intrinsic part of this project: one way of applying gender mainstreaming to gender non-related studies is to monitor gender representation in that field, and to pay attention to eventual differences among gender groups, without necessarily expecting any (i.e. no hypothesis).

So we noticed that females showed a tendency to use more words than male to describe their mood, where “more” means that they formed longer propositions, for example “happy but a bit tired and stressed” instead of “good” or “sad”. The length of the propositions seem to reflect an attempt to describe more complex moods, or to describe them more precisely (even if not necessarily complex). Generally “more” words also means that females employ a larger vocabulary, but it is not always the case (in the word count after the game, males used a greater variety of words than females). It is worth noting that even if using a greater variety of words to compose longer



propositions is a reasonable expectation, it is not a necessary implication. By clustering the words used by females vs. males, before and after the game respectively, we noticed that the mood of females before the game was strongly dominated by negative feelings (especially “tired” and “stressed”). So we decided to proceed with a further subdivision, isolating three different factors: gender, before/after the game, valence of the words (positive/negative). There was no doubt about the word subdivision as a function of valence, i.e. there was never a question, in our judgement, whether a word should belong to one group rather than the other.

**Fig. 4. Word clouds expressing the mood of the participants before (top) and after (bottom) the game.**



The trend in the transition from before to after the game stands out as positive for both groups, although in slightly different ways because the starting situation was different. Females showed a pronounced negative state before the game, and used more words than males to describe it. After the game, the mood of females increased significantly (7 different negative words before the game, for a total of 15 recurrences, and only 2 words after the game, each recurring once). While males also showed a decrease in the negative words (from 2 to 1), but in their case it is the positive words that increase in variety (5 different positive words before the game, for a total of 7 recurrences, and 8 words after the game, recurring 10 times). In our estimation, the increase in the variety of words should be regarded as a positive indicator because the richness of the experienced inner state evokes a greater variety of adjectives to describe it. Targeted future studies might address the question whether there is a connection between a session (about 10 minutes) of interacting with an artistic installation (which is expected to stimulate curiosity and creativity) and an (even temporary) increased capacity to feel and to perceive

richer nuances about the feelings. Besides feeding into studies in human psychology, which move away from the scope of this article, this information could be useful to inform the artistic design of installations with repeated or prolonged interaction.

#### IV. CONCLUSIONS

This article presented the preliminary results of an explorative study centred on interactive installation art. The initial assumption is that, at this stage of research, conservation and studies on aesthetic experiences share, together with artists, the same questions on how people interact with interactive installations today. Preliminary results show that the combination of different points of view allows to ask more articulated questions about installations, which is a step towards the definition of more sophisticated language and models to describe and archive them.

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