The Next Generation Poetic Experience

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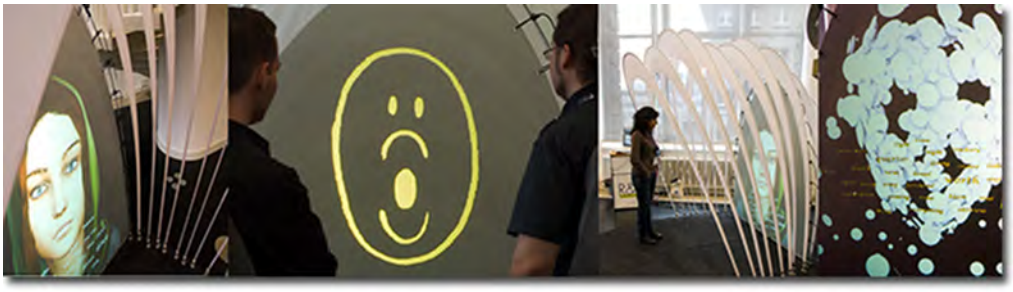

Figure 1: *Examples of interaction with the animated characters (Installation shots).*

Abstract

This paper presents the motivation, background and implementation of The Muses of Poetry, an interactive installation that combines dynamically generated character animation, semantic analysis, natural voice interaction and affect in poetry. Inspired by the subjectivity and ethereal quality of this literary art, we wanted to enhance the act of reciting poetry by providing a set of characters the possibility to "understand" and manifest the emotional content of the poems through facial expressions and affective speech. We believe that this original installation will bring poetry closer to a wider audience, while creating a playful, interactive and surprising experience for the user.

CR Categories: H.1.2 [Information Systems]: User/Machine Systems—Software psychology; H.5.1 [Information Systems]: Multimedia Information Systems—Animations; I.2.7 [Computing Methodologies]: Natural Language Processing —Speech recognition and synthesis, Text analysis

Keywords: human computer interaction, animated characters, affective computing

1 Introduction

During the last three decades the interaction with computer generated content has become a more natural and common thing to do. From the virtual characters usually exposed in kiosks at museums and airports, to the latest technologies used in installations where the user embodies an avatar and sees the world through its eyes, human-computer interaction, or HCI has undergone a large number of improvements. The numerous researches in this area have intended to achieve more natural and better interaction, obtaining successful results as in the case of Eva, a virtual geography teacher [Kasap et al. 2009]; the interactive football experts and moderator for the World Cup in Germany 2006 [Reithinger et al. 2006]; Max, the virtual museum guide who is in permanent exhibition at the Heinz Nixdorf MuseumsForum since 2004 [Pfeiffer et al. 2011]; and some other characters that have been used in more psychological and user experience experiments like MARC [Courgeon et al. 2009], Greta [Niewiadomski et al. 2009] or Alfred [Bee et al. 2009].

Poetry, for its part, is one of the most creative forms of literary expression. A good poem is not only capable of eliciting mental images and provoking feelings in the reader, but its rhythm and melody can transport this reader to the world created by the poet. This is reflected in the words of Emily Dickinson, who defined poetry in the following way "If I read a book and it makes my whole body so cold no fire can warm me I know that is poetry. If I feel physically as if the top of my head were taken off, I know that is poetry. These are the only way I know it. Is there any other way?" (L342a, 1870).

However, poetry has also gone through an interesting metamorphosis, not so much in its content as in its representation. The subjective characteristic of this form of art has awaken the imagination of numerous artists over time, bringing poetry closer to a wider audience. Media and interactive technologies have been often the ways in which poetry has been taken to new and fascinating levels, as described in Roberto Simanowski's book, *Digital Art and Meaning: Reading Kinectic Poetry, Text Machines, Mapping Art, and Interactive Installations* [Simanowski 2011]. In the book, Simanowski offers a semiotic analysis of different installations dealing with digital poetry. The main objective of these installations was to find new ways of representing the meaning of the poems, or providing users with a new way of experiencing poetry. That is the case of Naoko Tosa's MUSE [Tosa and Nakatsu 1998], where poems are created by exchanging poetic phrases between the user and the system; the latter being represented by a character which facial features are eyes, eyebrows and mouth. In Tosa's work, the facial expressions of the character change according to the emotions conveyed in the phrases uttered by the user.

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In the same direction of interactive systems the work of Kwiatek and Woolner [Kwiatek and Woolner 2010] merges poetry into interactive storytelling based on still and video panoramas. The aim of their application was to develop interest not only in the life of the poet Charles Causley but also in his literary output. Utterback and Achituv [Utterback and Achituv 1999] creates an interactive installation where letters fall like rain or snow, landing on the heads and arms of the participant's projection, and forming entire words and sentences of a poem about bodies and language. The L'Oréal Poetry Harp [Small Design Firm Inc 2004] is also an interactive installation where 28 cords stretched from the ceiling can be plucked and pulled, releasing sinuous clouds of letters (projected on the opposite wall) from poems about a woman's worth. Andromeda [Fisher 2009] is both a physical children's book and a digital book with AR codes that needs to be read with the use of a webcam. The poem is brought to life when a reader, using a camera attached to a computer, unlocks the textual, video and audio elements associated with the AR codes.

Another interesting field where creativity and technology play an important role is poetry generation. In this direction, some fascinating examples are the works of Colton et al. [Colton et al. 2012], Hervás et al. [Gervás et al. 2007], Greene et al. [Greene et al. 2010], or Cope [Cope 2011], just to mention a few.

This paper aims to shed light on the motivation, design considerations and implementation details of the interactive installation *The Muses of Poetry*, a new approach to experience poetry. The objective of the work is to explore how interactive animated characters can effectively transmit to an audience the intrinsic emotions conveyed in poems, expanding in this way the act of reciting poetry. The installation also intends to go a step forward in the computational creativity direction by bringing into existence a "virtual poetry interpreter". Here the meaning of the word interpreter is twofold. On the one hand, we intend our characters to come up with their own interpretation of the poems. On the other hand, the characters should be able to audio-visually translate the emotional meaning of the poems.

The last premise of The Muses of Poetry is to develop a novel autonomous system where all the processes, from the analysis of the poems to the generation of the animations are done automatically and in real time.

2 Background and Motivation

The idea for The Muses of Poetry was born out of our previous experiences with virtual characters for film productions and interactive applications. Evidence of this is the Agent Framework[1], a platform that allows the creation of application prototypes focused on the use of virtual characters. Having one user-friendly framework that allows the implementation of complex technologies like computer vision, synthetic speech, artificial intelligence and alternative input devices, it expanded the possibilities of creating applications beyond film and video games. One example is Emote[2] , a system that allows the creation of animated messages for mobile devices in real-time [Helzle et al. 2011]. In this application two characters are used: a realistic female character named Nikita, and a cartoon pink cow named Connie.

The other example is found in the context of interactive applications for medical therapy. From the cooperation with psychologists at the University Medical Center Freiburg arose the idea of using the Agent Framework in a pilot study to compare the performance of children with autism to the performance of typically developed children when recognizing facial expressions in virtual and real actors [Rauh and Schaller 2009]. For this study two realistic characters were used: Hank, a realistic male character, and Nikita. The acceptance of the characters by the users in both applications led us to continue using the Nikita character in other applications; for instance, as an interactive virtual presenter during the 16th Conference on Animation, Effects, Games and Transmedia - FMX 2011.

These results encouraged us to take our character to the next level: to recite poetry. However, reciting poetry out loud presents a major challenge because the reader needs to be aware of the style of the poem, the pauses, the melody and the ideas that this poem intends to convey. Having these elements in mind, we posed the following question: is it possible to have a virtual animated character that reads poetry? Can this virtual character make an audience connect with a poem, with its words and meanings? Can this character become a real "poetry interpreter"?

In the words of Stern [Stern 2003], the point of creating emotionally powerful experiences, whether interactive or not, is to induce a reaction in an audience, in "users". He claimed that people ask for experiences where they can interact with something that seems alive, that has feelings, that they can connect with. To that end, and to answer the former questions, we created an interactive and audiovisual poetry installation, which details we offer in the following sections.

3 The System

One of the novelties of the system is the combination of different areas like semantic analysis, real-time computer graphics, voice generation and human-computer interaction, in order to create artistic and well differentiated virtual characters that engage the user in a poetic experience. These elements have been implemented as modules of the architecture underlying The Muses of Poetry, shown in Figure 2.

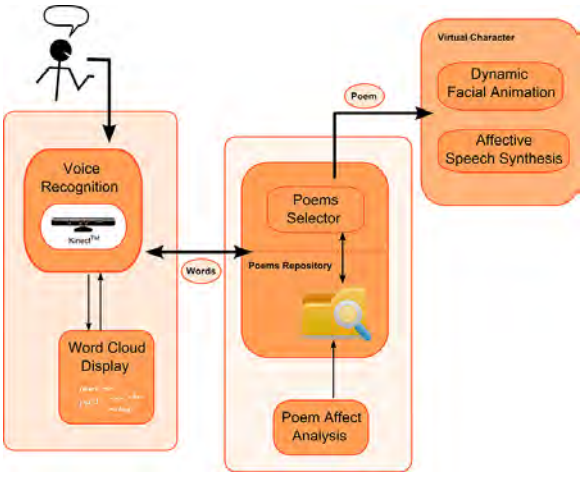

Figure 2: *Modules of the system behind The Muses of Poetry.*

3.1 Interaction: Voice Recognition and Cloud Display

The interaction with the installation was thought as a sort of conversation between the user and the character. Therefore, we needed a module for voice recognition that could encapsulate the voice interaction process, and display text that the user can say.

For the voice recognition we required the use of a microphone that could be reliable enough in noisy environments. Moreover, as we

[1] HTTP://RESEARCH.ANIMATIONSINSTITUT.DE/119.0.HTML
[2] HTTP://EMOTE.ANIMATIONSINSTITUT.DE/

wanted the interaction to be as natural as possible, we avoided using microphones that the user could grab, or see. After an evaluation of the options, we decided for the Microsoft Kinect array microphone, which captures the voice of the user and sends it to the Voice Recognizer. As a backup option, we installed a clip microphone in the back part of the second rib of the installation, right above the head of the participant, in case the first microphone would not work. Figure 3 shows the location of both microphones.

Figure 3: *Location of the clip (left) and Kinect (right) microphones (Installation details).*

When testing both microphones, the quality of the recognition was similar. The performance of the microphones was very satisfactory; however an interesting effect regarding the location of the microphones was noticed. With the Kinect microphone, which was located close to the projection surface and approximately 1 m above the floor, the users' first reaction was to approach to the Kinect, bend their bodies and talk as close as possible to the microphone. This surprising, but somehow expected behavior led us to choose only the clip microphone.

As for the interaction itself, it starts with one of the most common greetings: "Hello Muses". So, when the user stands at the entrance of the installation and says these words, the character replies: "Hello, I am one of the Muses of Poetry. Select two words and I will recite a poem for you". The decision of choosing two words came after some previous informal experimentation. We noticed that with three words, the user felt it was too long to start listening to the poem. On the contrary, the use of just one word was not engaging enough to make the user feel part of the installation.

The pool of words available for selection is presented by the Word Cloud Display module in a "word cloud" arrangement that is generated dynamically in every interaction. The first time the user approaches the installation the module displays a set of 30 words, chosen from all the poems in the repository by the Poem Selector. After a word is said and recognized, the selector looks for it in the current set of poems, keeping only the poems that contain that word. This new reduced set of poems makes the cloud to shrink, displaying the most frequent words in these new set. Once the user selects another word, and this is acknowledged by the system, the previous process is repeated again, and then the control is completely passed to the Poem Selector module. Figure 4 shows an example of interaction with the installation.

3.2 Semantic Analysis: Emotions from the poems

The Poem Affect Analysis module is the one that carries on the semantic analysis of each of the poems available in the installation, in order to extract their emotional content. This analysis is achieved by using the Whissell's Dictionary of Affect in Language (WDAL) [Duhamel and Whissell 1998]. This dictionary includes 10.368 English words with affective connotations, where each one is described with regard to the dimensions of Activation (or Arousal) and Evaluation (or Pleasantness).

Figure 4: *Example of interaction (Installation shot).*

Two reasons led us to decide for the Whissell's dictionary and not for others like ANEW [Nielsen 2011] or WordNet-Affect [Strapparava and Valitutti 2004]. First, the Whissell's dictionary has been created with words from literary and poetic texts. The other two contemplate mostly affective words, which are not enough to assess the whole meaning of a poem. Second, the number of words contained in Whissell's dictionary is greater than in ANEW and Wordnet-Affect. As a result, the majority of words used in poems are mostly recognized by the Whissell's dictionary and not by the other two.

The WDAL itself operates as a licensed stand-alone application that assesses the affective information of a poem in terms of activation, evaluation and imagination. It also provides a detailed classification of each word in the poem according to the following states: pleasant, nice, fun, passive, sad, unpleasant, nasty, active, high imagery and low imagery. The analysis itself is done in 3 steps:

- In a first step, the "global" assessment of the poem is obtained, which indicates if the poem is in general pleasant, nice, fun, passive, sad, unpleasant, nasty, or active. Additionally, a further classification is performed; if the poem resulted sad, unpleasant or nasty, then it is classified as negative. If the poem

resulted pleasant, nice or fun, then it is classified as positive. Note that at the moment, the high and low imagery states are not used.

- In a second step, each "word" in the poem is evaluated using the same states as for the "global" assessment.
- In a third step, a "line" assessment is performed. The motivation is that if emotions are associated to words only, then it might happen that the emotional connotation of the poem is distorted. To avoid this and to still manifest the emotional variability of a poem, a "line" analysis is performed. The reason why we use lines is that it is possible to extract out of them the idea and meaning that the poet wanted to convey. It is worth noting that a "line" of the poem is not necessarily the same as the written line (i.e. when separated by new lines). A "poetic line" is, in this case, the set of words, or lines, that enclose one idea of the poem. For the evaluation of the "line", the prevailing emotion in its set of words is the one assigned to that line.

3.3 Tagging of the poems

The process we previously explained can be performed in real-time for each poem in The Muses of Poetry. In this way, if a new poem is added to the system (as plain text) during the execution of the installation, it would be analyzed and stored in the Poem Repository. However, performing the affective analysis each time a poem is selected is resources-consuming; and the result would be every time the same given that the set of rules for this analysis are fixed. That is why a text tagging is executed when the poem is analyzed for the first time.

The main purpose of the tags is to indicate which emotional state to manifest in different parts of the poem. Facial expressions tags contain the name of the emotional state obtained from the analysis. These tags are added at the beginning of the line, e.g. `[synthesis:emotion id='UNPLEASANT_TRIGGER' /]`, and then interpreted by the real-time animation module to trigger the corresponding facial movements.

For changes in the speech, tags with prosody elements like "pitch" and "speech" are added before the words with the line's prevailing emotional state, e.g. `[synthesis:pitch level='79' ]`. These tags are processed by the text-to-speech tool SVOX[3], which in turn modulates the generated voice.

As for the poems, we only used free verse ones. It means that they do not use a consistent meter pattern or rhyme, tending to look and sound like prose. The motivation for using this type of poems is that we found them easier to associate with a set of emotions than other type of poems, like Haiku. The poems in The Muses of Poetry were obtained thanks to the collaboration with the Australian online magazine Cordite Poetry Review[4], which served as intermediary between a group of Australian poets and us. Besides that, other poets kindly provided us their poems under the Creative Commons license, having in the end a total of 21 poems. Once all the poems were analyzed, these were stored in the Poems Repository.

3.4 The Muses: Virtual Characters

One of the motivations for The Muses of Poetry was to have a number of characters that recite poetry and engage the audience by manifesting the emotional content of the poems.

[3]HTTP://WWW.NUANCE.DE/PRODUCTS/SVOX/INDEX.HTM
[4]HTTP://CORDITE.ORG.AU/

As mentioned in Section 2, the idea for this installation was originated by a realistic 3D female character, Nikita, who was used in former interactive applications. However, the appearance of Nikita was changed to make her look more "ancient Greek"-like. A research on antique Greek costume shed light on women's clothing. For instance, one of the most distinctive characteristics in the Greek Goddesses was the hair arranged in a somehow complicated fashion. The problem with this was the rendering in real-time of the hair of the character, which would have been time expensive. Instead, we got inspired by the style of a Cypriot woman from the 1st century B.C[5], who wore a cloak drawn over her head. This provided two advantages: no need to render the whole hair, and the fidelity to Greek clothing. Figure 5 shows two of the expressions manifested by the current female character.

Figure 5: *Expression of "Joy" (left) and "Unpleasantness" (right).*

The feedback from the audience when showing the new Nikita was positive. Even poets agreed that she conveyed emotionality. Nonetheless, other type of feedback indicated that users associated poetry with more abstract representations. Thus we looked for a character concept that went more into the abstraction direction. In the end, one of the Technical Direction students designed a character made of white-shaded swirling particles, whose face resembled a dynamic mask. The dynamism is provided by the swirling particles, which move all over the face.

The implementation of this character, whom we called Particles Head was done through a k-d tree based particle system, using a spatial hash table to further enhance its performance. The particles can be either emitted from a point, or randomized from a disk shape. Several types of affectors allow controlling the movement of the particles, as well as defining the shape and the flocking behavior of the particle cloud. The shape of the face is formed by an invisible mesh, which is used as a particle attracting affector. Furthermore, point and plane affectors push the particles away from the face surface to create the impression of eyes and a mouth.

Every particle of the character is visualized as a billboard that is aligned perpendicular to the direction of the affected forces. The billboards vertices carry position-, normal- and texture coordinate data. Based on this information we calculate a simple screen space ambient occlusion to underline the perception of the clouds volume. The final shape of an element is defined by an alpha mask, projected to the each billboard. Figure 6 shows the concept of the Particles Head.

Another character in The Muses of Poetry is a cartoonish one named *Myself*. This character belongs to the well-known German animator, Andreas Hykade, who lent it to us to be animated in real time. Figure 7 shows a set of poses of Myself.

[5]HTTP://WWW.METMUSEUM.ORG/TOAH/WORKS-OF-ART/74.51.2456

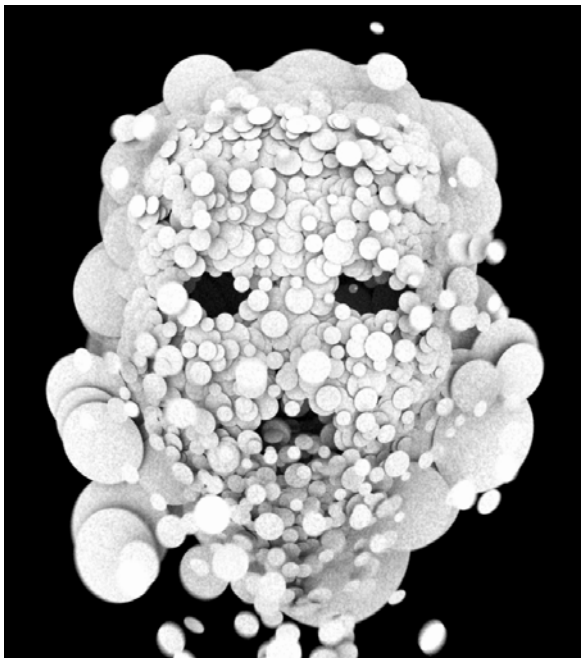

Figure 6: *Concept of the abstract Particles Head character.*

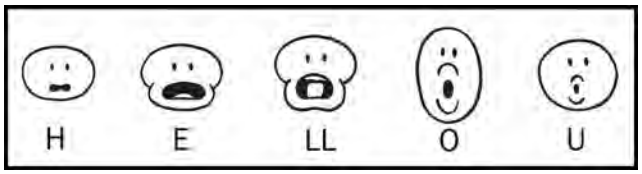

Figure 7: *Poses of Myself.*

Currently, we are in the process of integrating three new characters designed by three animation students at the Filmakademie Baden-Wuerttemberg, which will add variability and unexpectedness to the installation. The animation of these new characters will follow the methodology used for Myself, hence allowing a fast and easy integration. Figure 8 shows the new characters.

3.5 Dynamic Facial Animation

One of the main characteristics of The Muses of Poetry is the real-time generation of facial animations. In this way, there is no need of having pre-rendered animations for each poem. It represents a great advantage because any new poem can be added on the fly into The Muses without effort on the animation side. The development framework that provides this functionality is named Frapper[6], created at the Institute of Animation, Filmakademie Baden-Wuerttemberg.

In order to produce dynamic animations for Nikita, we used the Facial Animation Toolset[7], and in particular the Adaptable Facial Setup (AFS), which is part of a pipeline for the creation and animation of facial expressions in animated characters. The result was then exported to Frapper in the form of files containing the references to the object and its animation properties. Currently, these animations correspond to universal emotions like "anger", "sadness", "disgust" and "joy"; to idle states like "waiting" or "thinking"; or

[6]HTTP://SOURCEFORGE.NET/PROJECTS/FRAPPER/
[7]HTTP://FAT.RESEARCH.ANIMATIONSINSTITUT.DE

Figure 8: *Krel, a 2D character (top left); The Sailor, a clay character (top right); Woodo, a character made with real branches and stones (down).*

to "confirmation" of a recognized word. It is worth noting that the fact that a word like "happiness" or "joyful" appears in the poem is not an indicator that the expression of joy will be triggered. As mentioned in a previous section, is the general affective assessment of a line, contained in the corresponding tag, the one that decides for the type of animation to render.

Another important feature of Frapper that allows Nikita to talk is the automatic lip-synching. Thus, having previously defined the poses for each viseme (e.g., A, O, E, CH, I, F, M), these are displayed when the corresponding viseme is triggered by the speech synthesizer. A viseme is defined as a generic facial image that can be used to describe a particular sound.

Regarding the "Particle Head" character, no facial expressions were implemented because it would break apart the abstraction of the character. Nevertheless, the emotion manifestation is work in progress that will be achieved in a more creative way (e.g. colors, shape of the particles, and speed of the movements). As for speech animation, there are controllers that allow the opening/closing of the mouth, as well as the strength of the jet of particles that comes out of the mouth of the character when speaking. The viseme information is used once again to open the mouth in case of vowels like A, E, and O; to keep it close in the case of I and U, while streaming the jet; and to stop the streaming during the pauses. In the idle state the character becomes a cloud of particles that takes the shape of the head mesh as soon as the poem starts being recited.

To animate the Myself character, 16 visemes were displayed according to the ones triggered by the speech synthesizer. As a result, an animation of the character reciting the text of any of the poems is produced on the fly.

3.6 Emotional Speech Synthesis

The act of reciting poetry goes beyond words. Poetry needs to be felt in order to be expressed, and that is what we intended with The Muses of Poetry: to have characters who "feel" the poem and manifest it as well.

The great advances in text-to-speech technologies have made synthetic voices less robotic, more flexible and potentially emotional. Thus, in our installation we have taken advantage of the possibilities that the text-to-speech tool SVOX provides in order to manifest the affective content of the poems in the voice of the characters.

As a first step, we constrained the subset of emotional states to: happy, sad and unpleasant. This decision was made with base on previous works on affective speech, like [Schröder 2009], [Cowie et al. 2001], [Black et al. 2012], where it has been studied the changes in prosody that are necessary to achieve these states.

In the case of a "happy" voice (i.e. if the state is pleasant, fun or nice), the speed of the voice is slightly increased, while the pitch is more noticeable increased. In the case the voice is "unpleasant", also used if the state is nasty, the speed and pitch are both decreased. Finally, in the case of a "sad" voice, the pitch and speed are slightly decreased. At the moment the characters of the installation can talk with a male or female voice, in English or German.

4 The Installation

The Muses of Poetry as a physical installation resembles an open book, which white pages invite the user to enter and fill them with poetry. At the back there is a projection surface where the characters are displayed. One of the main advantages of The Muses of Poetry is its portability. Eleven (11) bendable ribs, one projection screen, and one fireproof floor carpet constitute the whole installation, which can be assemble and disassembled fast and easy. Figure 9 shows a side view of the installation.

The complete interaction with The Muses of Poetry has a maximum duration of approximately 3 minutes. It mainly depends on the length of the poems, but we have tried to keep them in the range of 1 to 2 minutes. As an open installation, The Muses has been designed to allow more than one person to experience the poetry. It is also possible that two persons take turns to say each of the initial words. At the moment, once the poem starts being recited it cannot be stopped, which we did on purpose to avoid interruptions and loss of engagement.

5 The Experience

The interactive installation we have presented in this paper intends to take advantage of the potential of different technologies in order to create affective animated characters that recite poetry. The Muses of Poetry is much more than just a "librarian" that performs a search of poems in a repository. It is a new way to experience poetry keeping the old reciting style, but enhanced with the affective component provided by the new technologies.

The words provided by the user, more than a way to choose a poem, serve as the bonding element between the user and the installation. When the participant approaches the installation, the main feeling is slight curiosity. This curiosity is increased by the character invitation to say two words. Then, when the characters begin to recite the poem, the curiosity is intensified by the fact that the user wants to hear the words he/she said, while experiencing the poetry.

As a final remark, it is not our intention to replace the poet with a virtual character. On the contrary, we intend to understand the affective process that undergoes when the poet reads his or her poem, how it can be expressed through facial expressions, and at some point enhance and support the performance of the poet.

Figure 9: *Side view of the physical installation.*

At the present moment, the installation is going through a tremendous growing. New poems and new characters are being included, thanks to the collaboration of the poets from the Cordite Poetry Review magazine and the animation students at the Filmakademie Baden-Wuerttemberg.

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