Nostalgia: A Human-Machine Transliteration

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Figure 1: *Nostalgia* in exhibition

Abstract

Nostalgia is an installation that draws attention to the computational challenges of understanding human emotion. Through affective computing and machine learning, the underlying system attempts to translate the components of the sentiment's qualitative makeup in quantitative terms. In *Nostalgia*, participants are asked to submit text-based memories, which are then used to calculate, predict and ultimately visualize relative nostalgia scores based on the aggregate of stories collected. However, given the ambiguities and complexity of human self-expression and the necessary precision of computational intelligence, *Nostalgia* highlights the entanglements of achieving emotional understanding between humans and machines.

Keywords: Art, Artificial Intelligence, Emotion Detection, Interactivity

1 Introduction

Computers are developing an emotional awareness and intelligence; however, humanity still struggles to understand our own emotional impulses and the extent of our emotional selves [1]. Despite the fact that computers now have the ability to distinguish simple emotions like joy, sadness, fear, anger and disgust based on human input, there are many indeterminate emotions that humans alone cannot define to one another let alone to a computer [2]. This gap in understanding is largely due to the complexity and dynamism of human consciousness [3].

To elaborate, emotion is often indeterminately complex, non-binary and nuanced. It is based on qualitative data and is subjective. In order for a computational system to make sense of emotions, these qualitative affects must be converted to quantitative facts and figures [4]. Certain emotions like nostalgia have been shown to be complex in their makeup and highly variable. Thus, how can we begin to explain to a machine these

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more nebulous and complex emotions if we ourselves struggle to define them?

This paper discusses *Nostalgia* (shown in Figure 1), an artistic installation that serves as an aesthetic representation of the emotion it refers to and the complexities that lie in achieving human-machine emotional mutual understanding. The following sections will describe an overview of the sentiment "nostalgia" and the state-of-the-art in emotion detection, detail the conceptual basis for and technical makeup of this work, and conclude with further thoughts and opportunities for ongoing aesthetic research in understanding complex emotions.

2 Nostalgia as a Complex Emotion

In an increasingly digital and technologically-driven world, nostalgia seems a timely sentiment. Possibly due to an increased reliance on intangible, often uniform technologies, there has been a revitalized interest in artifacts from the past [5]. In the entertainment industry, vinyl records have seen a surge of sales [6]. In the digital software industry, there have been heated debates about whether interfaces should incorporate skeuomorphic components, which serve as visual metaphors to physical objects and relics from the material world, versus flat components, which have been touted as more modern, contemporary and abstract [7]. Since nostalgia is a current and emotionally resonant sentiment, it motivated the design of this installation to reflect on the wabi-sabi nature of the human spirit juxtaposed with the exactness of computational realizations.

The feeling of nostalgia is most often associated with an individual's memories related to the past. While nostalgia can be felt from handling objects with sentimental value like photo books, it can also be felt from sensory actions like sounds or smells like freshly baked cookies [8]. Certain dates such as birthdays and holidays can also make one feel nostalgic. Thus, the impetus of nostalgia for an individual varies and can include experiences with persons, objects and events.

Interestingly, research shows that the feeling of nostalgia can also be felt at the communal level [9]. Assuming that community refers to a unified body of individuals with some common or shared interest or characteristic, entire populations or cultures can experience nostalgia. Some have even argued that cultural nostalgia has ignited national revolutions. For example, Svetlana Boym notes that "the revolutionary epoch of perestroika and the end of the Soviet Union produced an image of the last Soviet decades as a…Soviet Golden Age of stability, strength and 'normalcy'", and this in turn created a rallying cry for Russian solidarity [10].

While the definition of nostalgia has varied over time, researchers point out that the tendency to engage in nostalgic feelings also fluctuates over the course of an individual's lifetime [11]. Studies have shown that nostalgia can be felt for periods of time that have never even been experienced, thus muddying the most basic understanding of its place and purpose. For example, intergenerational nostalgia refers to memories of the past created through personal interactions with others who have lived through those past events [12].

Undoubtedly, nostalgia is a complex and complicated feeling. We struggle to define it to one another and break down how its simpler components such as happiness and sadness combine to create its emotional ethos. But, emotional awareness and emotional intelligence are pertinent characteristics in developing mutual understanding between humans and artificial intelligence (AI). Thus, the question ensues: If AI will ultimately be a reflection of ourselves, how will computers understand emotions we struggle to describe to one another?

3 Artificial Intelligence and Computational Emotional Intelligence

Artificial Intelligence is not a new field; however, recent years have seen a resurgence of its interest by way of new developments in sentiment analysis, psychometrics and affective computing. These technologies serve as mechanisms to detect and measure human emotion as a way to develop a computational emotional intelligence that can ultimately increase the relevance and usefulness of computers to humanity. In fact, many researchers have described this new wave of technological innovation, particularly the interest in artificial intelligence, as "the fourth industrial revolution" [13].

For years now, affective computing and sentiment analysis have been touted by the computer science community as key for the advancement of AI. In fact, Rosalind Picard in her book Affective Computing claims that "laws and rules are not sufficient for understanding or predicting human behavior and intelligence" [14]. Both academia and industry have followed suit, and the development of more robust sentiment analysis and personality insight tools have emerged throughout the past few decades. Several APIs have been developed from major companies such as Google's Cloud Natural Language[1], Microsoft's Text Analytics[2] and IBM Watson's Tone Analyzer API[3]. The prevalence of such APIs speaks to the popularity and potential value of understanding human sentiment. Currently there are two approaches for determining sentiment: detecting opinion and detecting emotion. The remainder of this section will focus on describing the state-of-the-art in emotion detection.

From a psychological point of view, there are a limited number of basic categories used to describe human emotions: anger, fear, disgust, happiness, sadness and surprise [15]. In more recent years, the emotion categories have been further reduced: happiness, sadness, fear/surprise, anger/disgust [16]. Detecting these emotions through text alone is not trivial. Humans give emotional cues through facial expressions and voice intonation. Thus, from a computational standpoint, translating dynamic human qualitative phenomena into quantitative data by focusing on written text alone removes much of the context that we rely on as social cues.

Nevertheless, popular sentiment analysis systems today analyze written word and calculate tone scores for each of the categories, yet several significant interpretive hurdles still exist. For example, the length of the text can be a challenge as user review data on popular web platforms such as Amazon and Yelp show that humans have a tendency to change their mind, often mid-review [17]. For example, when reviewing a place, one might say "Overall the restaurant was great, but the service was horrible. I'm not sure that I'll come back because of that." Other challenges include understanding parts of speech (certain languages have difficult tense rules) [18], negation (double negatives can be problematic) and mixed-affect sentences (especially lengthy sentences that vacillate from positive to negative) that need to be assessed in order to determine the appropriate sentiment [19].

Despite tremendous research efforts and computational breakthroughs, sentiment analysis is by no means a solved problem. Emotion is nuanced and dynamic, even for simple emotions that are more easily recognized. Thus, how might one

1 https://cloud.google.com/natural-language/

2 https://azure.microsoft.com/en-us/services/cognitive-services/text-analytics/

3 https://www.ibm.com/watson/services/tone-analyzer/

begin to computationally understand more complex emotions like nostalgia? Researchers have begun to conduct qualitative studies aimed at standardizing the measurement of nostalgia [20]; however, a computational solution is lacking. This gap inspired the creation of *Nostalgia*.

4 NOSTALGIA: THE INSTALLATION

Nostalgia invites participants to share their stories, and in the process, engage in an inter- and intra-personal conversation about feelings of nostalgia. The installation is designed to ground our conceptual notions of nostalgia in participant interactions. First, participants are asked to enter a story or memory on a keyboard guided by a software user interface. Then, the computer tries to make sense of the story, reflecting its understanding through both a digital visualization and a physical embodiment of its understanding. Light-based sculptures are positioned in front of the keyboard entry pedestal as detailed in Figure 1, which change hue based on the nostalgic strength of participants' entries. In other words, through participant actions in the form of storytelling, the algorithmic system converts the qualitative affect of nostalgia to a quantitative digital and physical aesthetic representation. Metadata, like time and occupancy, are captured at the moment of submission to help the system predict the degree of nostalgia for future contributions. Some of the questions the installation seeks to answer are: How can we quantify feelings of nostalgia? Does our sense of nostalgia change as we gain awareness of it in real-time? Are we more likely to be nostalgic when we're around others? Are we humans so alike that we can begin to predict when and how nostalgia might arise?

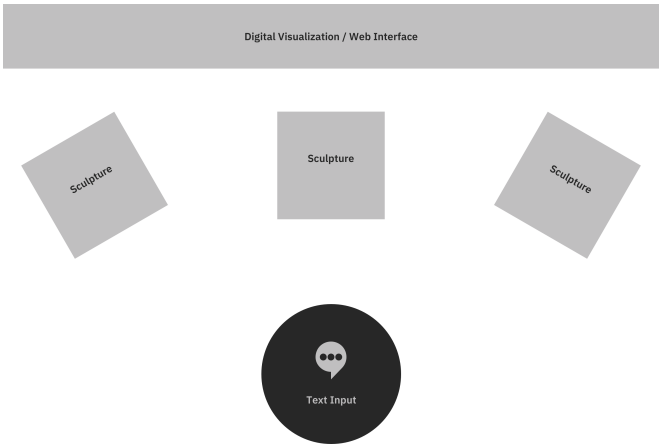

Figure 1: *Nostalgia* Floor Plan.

Functionally, the installation hinges on a web application that both collects and visualizes participant contributions. In a physical space, participants are asked to type a memory, something that evokes an emotional response. Upon written submission, the system computes a nostalgia score/index ranging from 0-100 based on an algorithmic model, which is driven by a machine learning algorithm that was trained with texts classified against the Southampton Nostalgia Scale [21] coupled with IBM's Tone Analyzer API. Because nostalgia is a complex emotion derived from simple emotions, specific keywords and a predilection for past-tense parts-of-speech, the underlying model relies on these three components to determine a quantitative value for scoring a contribution's nostalgic content. Meanwhile, the installation captures the number of potential spectators who are either physically (through Bluetooth connectivity) or digitally (through web socket connectivity) present.

In order to train the model, close to two-hundred narratives were leveraged from studies conducted by the University of Southampton's Nostalgia Group[4]. These narratives had been previously coded as "Ordinary" or "Nostalgic" based on the group's derived Nostalgia Scale. Once collected, the narratives ran through IBM Watson's Tone Analyzer API to determine the breakdown of their simpler emotions—joy, sadness, anger, fear, disgust. In effect, the contributions served to train a logistic regression model to classify how strong a future nostalgic text would be based on the makeup of these simpler emotions.

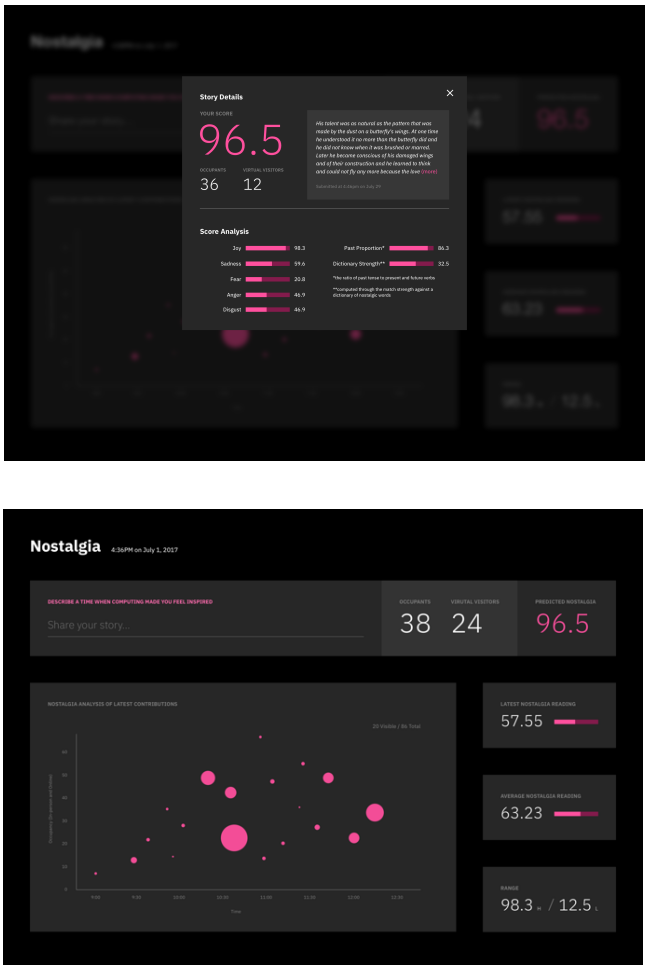

Figure 2: *Nostalgia* Web Application displaying a computational breakdown of the nostalgia submission components (top), *Nostalgia* Web Application in default state (bottom)

Building on the logistic regression derived from simpler emotions, two additional components were added as weights in an aesthetic attempt at deriving a truer computational nostalgia index. First, the system uses a parts-of-speech tagger[5] to identify the proportion of past-tense versus present- and future-tense verbs. The proportion is set as a relative value against all contributions and serves as a weight to either augment or diminish the value produced from the logistic regression. The second component alters the score based on keywords, such as "home", "past", "childhood", determined to be more likely nostalgic from prior studies [22]. Combined, these three facets drive *Nostalgia*'s indexing mechanism.

4 https://www.southampton.ac.uk/nostalgia/index.page?
5 https://nlp.stanford.edu/software/tagger.shtml

Once an index has been determined, participants are able to see a visualized breakdown of the pre-defined factors that contributed to the score along with a timestamp and occupancy and virtual visitor count illustrated in Figure 2. The occupancy count uses Bluetooth to calculate the number of connected smartphones as an approach to determine how many nearby participants could read a contribution's real-time entry. The virtual visitor count uses a web socket[6] to allow remote users to access the web application and read contributions entered in real-time. As a result, the participant's entry, nostalgia score, occupancy (both physical and virtual) count and timestamp act as inputs into a multiple regression model, which attempts to predict how nostalgic the next contribution might be given these external factors.

Aside from entry, the installation poetically visualizes nostalgia and the data captured through contributions in a variety of forms. From a digital standpoint, all contributions can be seen on a scatterplot which plots an individual story against time and occupancy (both physical and virtual) count as seen in Figure 2. The radius of each point is determined by its nostalgia index. Additional at-a-glance metrics are shown as modules on the right-hand side of the screen including: the index of the most recent contribution, the average score of all contributions and the range of all contributions. An entry module exists at the top of the screen, which consists of a text input, allowing participants to input a story and real-time statistics on the aforementioned occupancy counts. Lastly, the score prediction value appears at the far right of this module, which leverages real-time data (time, occupancy and virtual visitor count) to compute the nostalgic strength of the next contribution.

Figure 3: *Nostalgia*, Light-based sculpture

In effort to pay homage to the physical nature or object-form of nostalgia, the installation also features a set of three electro-mechanical sculptures seen in Figure 3. The sculptures, or "time-boxes", serve as physical embodiments of the components of the installation. Each sculpture is cubic in form and consists of black acrylic and a translucent front plate. Within each box is a set of RGB LEDs which emit a rose-colored hue. On the face of each box is an hour-glass connected to a stepper motor that rotates it programmatically. Various representations of nostalgia in the overall piece map to these sculptural components. Stronger nostalgia scores correspond to rosier hues emitted from the LEDs and slower rotations of the motor which drives the hourglass. The former mapping pays homage to the phrase "viewing the world through rose-colored glasses" while the latter mapping suggests that stronger values of nostalgia are tied to more descriptive and ultimately longer phases of reminiscing.

Many people in the Western world are familiar with the idiom "looking at the world through rose-colored glasses" [23], and it has a scientific corollary known as Rosy Retrospection. This notion refers to the tendency for people to remember events and their experiences more fondly or positively than they evaluated them to be at the time of their occurrence [24]. It is in this vein that the work achieves its visual aesthetic referring literally to the word "rosy". Stronger nostalgia scores correspond with rosier hues throughout the work.

The work leverages hourglasses in each sculpture in effort to symbolize the time-based aspect of nostalgia,. Time is often considering a fleeting phenomenon, and the sentiment of nostalgia, and more broadly memory, can be thought of as mechanisms to preserve its state. The hourglass components serve to embody the preservation of time in both their rotational speed and rest interval. Higher nostalgia scores correspond to slower rotations and longer rest periods in effort to hold on to the moment.

5 Initial Exhibition Reflections

Nostalgia debuted at the L.A.S.T. Festival run by Stanford University[7] in April 2018. The installation was part of a group exhibition that took place SLAC National Accelerator Laboratory and was the first art exhibition to-date in the particle accelerator lab. Over two exhibition days, participants submitted a total of 284 contributions. The average nostalgia score during the exhibition was 55.3 and the range spanned 0.2 to 98.2. From qualitative observations there appeared to be a wide range of submission types regardless of small or large crowds of spectators. Contributions ranged in length as well. For example, a longer story read “Living in the 80's was a time where we were young and experienced lots of memories, living the good life, and doing things that has age limits and no age limits. Doing the things that, some, wouldn't last forever as things changes all the time in life. I was a part of that and feel blessed and happy that I was able to do these things as time went on,” and received an 86.51 score. Whereas an example of shorter story read “that whole decade when laserdiscs were a thing” and received a score of 90.08. Overall, contributions varied in content, length and score, and the variety of data input into the system will lay the foundation for ways that the nostalgia indexing mechanism can be improved in the future.

6 Conclusion

While the scientific community has seen significant strides in understanding basic emotions, more complex emotions like nostalgia are still conundrums. In the race to conceive a general artificial intelligence, one that can truly understand and benefit humanity in the way that scientists, technologists and researchers desire, emotional intelligence and awareness are key.

Nostalgia is an effort to call attention to a number of issues surrounding a machine understanding of human emotion. Not only does the work seek to inform, but also to serve as a catalyst and instigator for further questioning of the potentials, benefits and dangers of a highly capable computational emotional intelligence. Through aesthetically bridging both physical-digital and human-computer relationships, the piece seeks to play with our existing relationship with our machines and the existing gaps and opportunities, left in translation. Direct translation between

6https://developer.mozilla.org/en-US/docs/Web/API/WebSockets_API

7 http://www.lastfestival.com

the qualitative and quantitative, human and machine, can only take us so far.

As technology continues to make up the fabric of daily life, more of our lived experiences are being captured. The notion of the "quantified self" or lifelogging, which describes the movement of ubiquitous data acquisition of a person's daily life, is no longer that of science fiction but of reality [25]. While many may pontificate about the impact of lifelogging on emotion, it is unclear how an emotion like nostalgia, which relies so heavily on memory will be impacted. Furthermore, the way in which stories are captured occurs in more distributed ways—the number of devices we have to communicate with one another has shifted drastically over the past few decades. Thus, if one were to maintain records of events and precise emotions felt during them, how would this impact our emotional awareness and intelligence toward one another? How will the distributed nature of experience impact emotion? And how will a potential shift in emotional intelligence impact the way computational systems are trained to detect emotion? While it may be too early to predict the impact innovation will have on our humanness, it is worth exploring these areas of aesthetic inquiry.

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