Live Sentiment Annotation of Movies via Arduino and a Slider

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Abstract. In this contribution, we present the first version of a novel approach and prototype to perform live sentiment annotation of movies while watching them. Our prototype consists of an *Arduino* microcontroller and a potentiometer, which is paired with a slider. We motivate the need for this approach by arguing that the presentation of multimedia content of movies as well as performing the annotation live during the viewing of the movie is beneficial for the annotation process and more intuitive for the viewer/annotator. After outlining the motivation and the technical setup of our system, we report on which studies we plan to validate the benefits of our system.

Keywords: Sentiment Annotation, Sentiment Analysis, Movies, Movie Annotation, Arduino, Slider

1 Motivation

The research areas concerned with the computational prediction and analysis of sentiments and emotions, predominantly in written text, are referred to as sentiment and emotion analysis respectively [16]. The main application area of sentiment analysis is user generated content on the web like social media [8] or movie reviews [12]. However, in recent years, sentiment and emotion analysis has been explored in the context of the Digital Humanities (DH), more precisely Computational Literary Studies.

1.1 Sentiment and Emotion Analysis in Digital Humanities

Overall, one can identify an increasing interest for sentiment analysis among literary studies in recent years. Researchers explore the results of the application of sentiment and emotion analysis in various literary genres like plays [18, 20, 24], novels [11] and fairy tales [1, 2, 18]. Sentiment analysis is also used to predict "happy endings" in novels [9], to identify plot arcs in stories [23], to predict genres [15] or to compare the sentiment expression in the text and the audiobook of a play [26]. A more in-depth analysis of the state of sentiment analysis research in Digital Humanities can be found in Kim and Klinger [13].

Currently, the focus of research is predominantly on text, esp. traditional text genres like novels and plays. While there are some first explorations of multimedia content like audiobooks [26], the application of sentiment analysis on movies has hardly been explored so far: Öhman and Kajava [21] have developed *Sentimentator*, an an-

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notation tool specifically designed to annotate sentiment and emotion for movie subtitles. Chu and Roy [6] explore multimodal sentiment analysis in videos and focus on short web videos to identify emotional arcs.

We argue that similar to literary studies, emotions and sentiments of the characters in the movie play an important role in the analysis and interpretation of a movie. Advances in sentiment analysis for this type of media could lead to large-scale analysis examining sentiment and emotion progressions and distribution in entire genres or epochs. Insights gained by such analysis are of large interest for film scholars. For such large-scale movie analysis via computational methods, the term "Distant Viewing" was framed [1, 4].

1.2 Sentiment and Emotion Annotation of Literary Texts and Movies

An important part in the process of sentiment analysis for a specific domain is the creation of large, well-curated corpora annotated with sentiment and emotion information. These corpora allow for the application of advanced machine learning approaches but also for systematic performance evaluations of various approaches. While these corpora are rather easy to acquire in the context of social media and product reviews e.g. by using *Amazon Mechanical Turk* [29] it has been shown that the annotation of literary texts is more challenging [2, 25, 26]. Due to the current lack of annotated corpora, researchers often employ rule-based sentiment analysis approaches (dictionary-based approaches; c.f. [13]). These are oftentimes not optimized for the specific domain and vocabulary of literary texts and are often out-performed by machine learning approaches [13, 29].

There are various reasons for the lack of annotated corpora for literary texts. Sentiment annotation for this text sort is currently done with text-based annotation tools enabling the annotation of passages [25, 26] or more complex relations in the text [14]. However, annotators perceive the task as very challenging and tedious [2, 25]. If the annotators have no specific expertise, they report many problems with the language and the missing context [2, 25, 27]. Furthermore, narrative texts are generally more prone to subjectivity since they can be interpreted in different ways. Therefore, annotation agreements are rather low [2, 25, 27], which is also a problem for the successful creation of corpora and the application of machine learning. In the context of movies, sentiment or emotion annotation projects are rare and mostly focused on the annotation of the textual content of movies like the subtitles [21]. Due to similar challenges like the ones with literary texts, Öhman and Kajava [21] developed a tool employing gamification to facilitate the sentiment and emotion annotation process for movie subtitles.

1.3 The Need for Live Sentiment Annotation

In the following, we present an annotation process using an Arduino and sensor sliders for live sentiment annotation of movies. Annotators can perform the annotation while watching a movie on a TV screen and adjust the sentiment during the viewing of the movie via a continuous slider (e.g. from negative to positive sentiment) at the

side of their chair (see chapter 2). The changes of the slider are saved via a Python script and can be aligned with the movie.

We argue that the lack of the presentation of the audiovisual modalities , which are of course important parts of movies, and the sole focus on text in sentiment annotation for movies can lead to many of the problems concerning sentiment and emotion annotation mentioned in chapter 1.2. We want to highlight that textual sentiment annotation of movies might still be reasonable for certain tasks e.g. multilingual analysis of emotions of subtitles [22]. However, for our specific goal of the annotation of the expressed sentiment of the characters in a movie, we argue that our approach has multiple benefits.

First, movies are multimedia artefacts and the lack of the presentation of the video and audio channels leads to information loss. Many emotions are expressed via the face and the voice of the actor and not just the text. Therefore, viewers might be able to annotate sentiment and emotions easier and more consistent when experiencing the entire movie, thus leading to higher agreement levels among annotators. Additionally, a lot of context that might be important to understand the feelings of the characters might be expressed via other channels than the text. Furthermore, emotions are also often expressed without saying anything in a movie. Textual annotation only allows the annotation of parts in which characters talk, everything else is neglected. This will certainly lead to incorrect and incomplete sentiment annotations for certain movies. While there are video annotation tools that offer the video and audio channel to be used for movie annotation, they often need training before usage and rather support asynchronous work needing to constantly pause and adjust the time and frame of the movie for the annotation (e.g. [7, 17]). We, however, argue that live annotation during the viewing of the movie facilitates the annotation process because the viewer/annotator can directly and immediately assign their annotations based on what they are experiencing. Furthermore, the usage of a continuous slider might also resemble the rather vague concept of sentiment much more than nominal class assignments [5, 24] or ordinal ratings [19, 28] often used in textual sentiment annotation. Following Nobel laureate Daniel Kahneman's line of thought, annotating in the actual movie watching situation might come closer to emotional reality than more reflective post-hoc annotation [10]. Finally, we argue that our annotation process is more in line with the private viewing behavior and annotators do not need to learn and use complex annotation tools; thus the annotation might not be perceived as much as tedious work than it has been in the context of textual sentiment annotation of literary texts.

Please note that while we focus on sentiment annotation for our study, the system can be similarly used for every sort of emotion or other scale for which one desires live movie annotations. Furthermore, our motivation for live multimedia annotation also holds true for theatre plays (and performances) which, similar to movies, are mostly analyzed based on their textual content [18, 20, 24]. Our system is not dependent of the content of the presented video and can easily be applied to theater recordings but also TV series or other kinds of videos. Additionally, while the task in our annotations is to mark the sentiment of the characters on the screen, our system can also be used in viewer response studies of various forms in psychology.

2 Approach

In this chapter, we sketch our technical setup and describe the actual annotation process.

2.1 Technical Setup

The annotation system consists of an Arduino microcontroller connected to a linear potentiometer, which, is paired with a slider. Figure 1 shows the system's hardware.

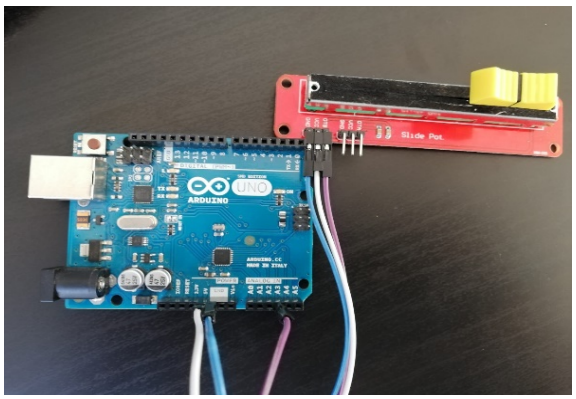

Fig.1. Arduino (blue) connected to a slider with integrated potentiometer (red).

The Arduino itself has to be connected to a computer running a Python script. The script represents the core of the system, it is responsible for reading the current value of the slider, logging it and presenting it to the user in a small GUI while watching the movie on a TV. The slider depicts continuously changing resistance levels between 0 and 1023; these values may be translated programmatically to other scales. The python script, running in the background (e.g. on a laptop connected to the TV), records these values simultaneously and it shows the user the current slider position and thus the currently selected value in a simple GUI. Figure 2 depicts the user view for an exemplary application in a movie annotation.

Fig. 2. Example scene from a TV show (left). Python script displaying the currently chosen value on the Arduino slider. The GUI also depicts a rudimentary scale (right).

2.2 Annotation Process

For the annotation process, the annotator/viewer will be presented with the movie and the interface as shown in figure 2. Additionally, the annotators are equipped with the cased Arduino slider. Figure 3 shows an early prototype of the sliders encasing.

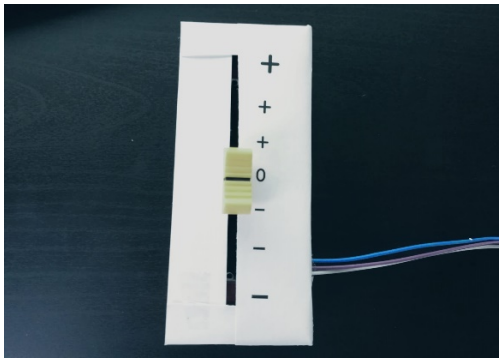

Fig. 3. Prototype of the slider casing. The shell also features a rudimentary scale allowing the user to navigate without the GUI. Please note that the slider is continuous and not nominal.

The slider will be operated by the user while watching a movie or TV show and is placed at the side of his chair so the viewer can adjust the scale intuitively with his hands, while watching the movie (figure 4). The slider is portable and can be placed as the viewer wishes. During the study, the value of the Arduino slider, time-stamped,

is read and logged by the Python script every 100ms. By saving the timestamp, the slider value can be exactly assigned to a certain time in a film or TV program in a subsequent data analysis. The movie shown as well as the slider are synchronized via a Python script connecting the slider and VLC-player, which is the media player we use to present the movie.

To start the annotation, we simply connect a laptop with a TV and start the script and a movie via VLC-player. The annotators can also stop and continue the movie as they wish without deranging the synchronization. The final output is currently a simple table with the value of the slider for every 100ms. Via post processing, we can therefore precisely acquire and visualize the sentiment progression of a movie according to the annotator.

Fig. 4. Slider case at the side of the seat during a live annotation.

3 Future Plans

While we argue that our concept is beneficial for the sentiment annotation process of movies, we have yet to evaluate our approach to validate the assumptions we make in chapter 1. We currently plan first sentiment annotation studies for movies to evaluate the system. To perform this evaluation, an adequate number of annotators will perform the annotation of a small number of movies via our system. They will be introduced to the annotation process and then have to watch a movie and annotate the sentiment expressed by the characters in the film. For valid evaluations, we plan to compare this annotation process with (1) the same type of annotations of solely the textual content of the movies and general annotation tools as well as with (2) video annotation tools. We will analyze the differences in annotation behavior as well as the perceived effort via standard usability metrics. We will also examine how computational sentiment analysis approaches, being textual or multimodal, perform in light of the annotation and which approach mostly resembles the annotations by viewers.

To gather valid and large-scale corpora with sentiment or emotion annotations, it is important to find a fitting and easy-to-perform annotation process. While the approach is still limited since the annotation of one person takes at least the time of one movie, we argue that it is a step forward compared to traditional annotation methods. Furthermore, even with a moderate size of annotated movies we can work towards the usage of advanced machine learning approaches.

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