SmileTracker

SmileTracker: Automatically and Unobtrusively Recording Smiles and their Context

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Abstract
This paper presents a system prototype designed to capture naturally occurring instances of positive emotion during the course of normal interaction with a computer. A facial expression recognition algorithm is applied to images captured with the user's webcam. When the user smiles, both a photo and a screenshot are recorded and saved to the user's profile for later review. Based on positive psychology research, we hypothesize that the act of reviewing content that led to smiles will improve positive affect, and consequently, overall wellbeing. We conducted a preliminary user study to test this hypothesis, as well as to gather feedback on the initial design.

Author Keywords
Positive emotion; wellbeing; facial expression recognition

ACM Classification Keywords
H.5.m [Information interfaces and presentation (e.g., HCI)]: User Interfaces.; I.4.9. [Image Processing and Computer Vision]: Applications

Introduction
While maintaining positive emotion is an important component of overall wellbeing [11], many of us may find staying positive while working at our computer to be a difficult task. This is unfortunate, given the profound

benefits positive emotion can confer. When individuals are in a positive state of mind, they show improved cognitive resources and an increased ability to think creatively and expansively [4]. The ability to experience positive affect while under stress has been shown to mediate the damaging physiological effects of stress [4]. Further, experiencing positive emotion while at work has actually been shown to increase productivity [8].

For these reasons we created a prototype system dedicated to the generation and preservation of positive emotions during normal work performed at a computer. The idea is to use facial expression recognition to detect when an individual smiles in front of her computer, and capture the image which made her smile. These images can then be stored for the user to later review, which may have several benefits. First, the system will be able to store a collection of content that causes the user to smile, which she can use to bolster her mood whenever she feels in need of comfort or encouragement. Further, we expect that the system will facilitate deliberately recalling positive moments that occurred throughout the course of the day, an exercise which has been shown to improve positive emotion [11]. Finally, by linking the site to social networking platforms and providing the ability to share or publish photos and content, we hope to provide a platform for contagion of positive emotion.

Related work

A number of systems have looked at detecting emotions using facial expressions, which are surveyed in [3]. Only a few of these systems provide emotional feedback to users. AffectAura estimates the user's emotional valence, arousal, and engagement, and displays this feedback in real time as well as recording it in a diary [7]. MoodMeter displays a smiling or neutral icon over faces of students recorded in various points in a university; the authors analyzed smile frequency both spatially and over time [5]. Smile Catcher encourages participants to use Google Glass to record as many smiles as possible, thus inspiring them to generate positive emotion in others [2].

SmileTracker makes several contributions to previous work. Rather than simply recording smiles, it automatically records content that causes users to smile. The system will collect and store a repository of happy memories or funny moments that the user can look back on in order to promote positive emotion. Like other systems, it also encourages social contagion of positive emotion, but in this case by making it easy for users to share the content that makes them happy. Finally, SmileTracker is designed to promote positive emotion in the normal daily context of using a personal computer.

System design

In order to allow us to easily deploy SmileTracker to a wide range of users, we built a web application which is currently hosted at `http://smiletracker.net`. Several steps were taken to encourage social contagion of positive emotion. Users log in to the site using their Facebook account, and are taken to a personal profile page (see Figure 1), which shows a series of smile and screenshot photos displayed together. For each individual photo, the user has the option to delete it, share it to Facebook, or publish it to our public SmileTracker gallery. The gallery contains images published for the benefit of other users; one participant chose to share a screenshot taken of her final paper as she finished writing it and smiled. The decision to allow users to manage each photo individually was taken in order to increase user control and freedom; we anticipated that some users would be willing to share the content that caused them to smile but would not feel

comfortable sharing their own image, while the reverse would be true for other users (in the future we intend to provide the ability to publish both images together).

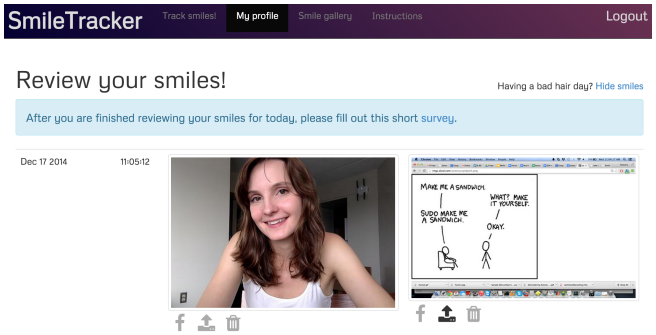

Figure 1: User profile page which allows users to review, share, publish, or delete photos.

Smile detection algorithm
To capture new photos, the user navigates to the *Track Smiles* page (see Figure 2). The smile detection module uses a javascript library called js-objectdetect[1] for real-time object detection [12] [6], which is compatible with stump based cascade classifiers used by the OpenCV [1] object detector.

A face detection algorithm using the stump-based 20x20 gentle Adaboost frontal face detector in OpenCV is applied to the raw webcam video. If the detector finds multiple potential face objects within the frame, neighboring detected objects will be clustered as a single face, and the number of neighbors will be counted as the detection confidence of the face. The region with the maximum confidence will then be segmented for the next detection. At this point, a smile detection algorithm based on the Haar cascade smile detector contributed by Oscar Deniz Suarez in OpenCV is implemented over the segmented facial area using the same search method. The detection confidences are shown as smile intensities on the page in real time.

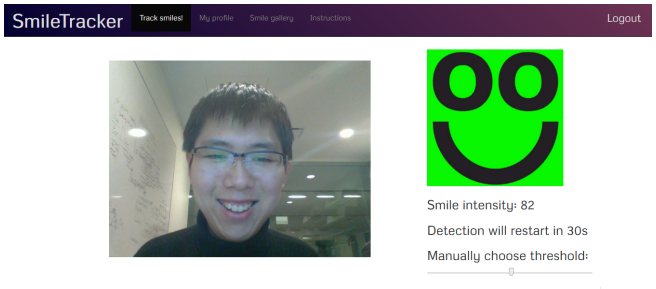

Figure 2: Smile detection page.

We adopt a simple judging system with a smile intensity threshold to distinguish smiling moments. Once a user's smile intensity crosses a set threshold, a photo and a screenshot will be taken, and a green smiling face displayed. The system pauses 30 seconds before taking the next photo, to prevent too many photos from being taken consecutively.

Screenshot functionality
Since the screenshot function involves privacy and security issues, it was implemented as an embedded Java applet. This proves to be the easiest way to deal with the security issues, as the users only need to put our website address on their Java exception site list without modifying any system file. Because users often have multiple monitors connected to a single computer, the applet extracts the location of the mouse cursor first so as to only capture the screen of the active monitor.

[1] https://github.com/mtschirs/js-objectdetect/

Modifications based on initial feedback
Because individuals vary greatly in their smile intensity, initial system testing revealed that using a pre-set threshold was insufficient. Therefore we added two mechanisms to account for user differences. We first set the threshold adaptively, to the mean of the smile intensities observed so far plus five standard deviations. This modification was designed after observing graphs of smile intensities over time; it appears that for most individuals, smiles appear as a sharp spike in intensity above a relatively low baseline. To account for individuals with highly variable smile intensities, we also added the ability to set the threshold manually.

User evaluation

We evaluated our system in two ways. First, we tested our hypothesis that reviewing photos of positive moments would increase positive emotion. To accomplish this we designed a short survey to assess three aspects of the user's emotional state using a sliding scale from 0 to 100: energy, positivity, and stress. The scale design was based on previous work on single-item affect scales for reporting valence, arousal [9], and stress [10]. In order to test whether our system can increase positive emotion, we prompted the user to fill out a survey before and after they review their photos. At the beginning of each day, the user is forced to complete the $before$ survey before she can access the site. Then, a prompt at the top of the user profile page (see Figure 1) asks the user to complete the $after$ survey once she is finished reviewing her photos. She will also be taken to the $after$ survey page when she logs out of the system.

Note that we chose to gather the survey data in a naturalistic setting while participants are actually using the app. Since the before and after surveys are not administered as part of a controlled experiment, even if we observe a significant increase in positive emotion we cannot be certain it was caused by SmileTracker. We made the choice to gather the surveys in this way because a controlled study in the lab conducted over a limited time interval would be unlikely to allow them to gather many spontaneous, naturally occurring smiles. Without the ability to collect a series of smiles that were generated by looking at positive content throughout the day, the true function of SmileTracker - encouraging the user to reflect on positive moments that occurred over the course of a day - could not be realized. In that case the external validity of the experiment would be compromised.

We also collected qualitative feedback about how to improve the system. After participants had experience with SmileTracker, they were asked to complete a questionnaire with items asking about any problems experienced with the system or the smile detection algorithm, and suggestions for improving the site. All evaluation protocols used in this study were approved by the MIT Committee on the Use of Humans as Experimental Subjects (COUHES), and the results of both forms of evaluation will be discussed below.

In total, 34 people registered for the site using their Facebook accounts, of which 22 gave informed consent to participate in the study. After 18 days of data collection, the application had collected more than 1099 images. Over 87 $before$ surveys were completed, indicating that collectively, participants used the site for more than 87 days. Of these 87 $before$ surveys only 29 had a corresponding $after$ survey; in the future we intend to email participants with a reminder to complete the survey at the end of the day. Considering we did not offer monetary reward for participation, we believe that the

quantity of data collected reflects an encouraging level of interest in the application.

Quantitative feedback
In order to assess our hypothesis that reviewing captured photos will improve happiness, we analyzed the 18 completed $before$ and $after$ surveys which came from consenting participants, and the results are shown in Table 1. We found that while stress decreased and arousal increased between the two reporting periods, these differences were not significant. However, participants did show a significant increase in positive valence between the $before$ and $after$ surveys. This could be taken as preliminary evidence that reviewing the collected smiles increases positive emotion, although further investigation is needed to confirm this effect.

Measure	**Mean change**	**SD change**	t	p
Arousal	5.33	21.17	1.07	$p>.05$
Valence	8.28	18.11	1.94	$p<.05$
Stress	-3.28	10.32	1.32	$p>.05$

Table 1: Change in measures calculated as the difference between $before$ and $after$ surveys reported on the 0-100 scale.

Because this is a preliminary study, we cannot be sure that SmileTracker (and not a confounding variable) caused the significant increase in positive emotion that we observed. We found that on average, the after survey was completed 34.5 minutes after the before survey, and the median time difference was 6.8 minutes[2]. This shows that the length of time over which the significant increase in positive emotion occurred is quite small. Since the time interval is short, it is less likely that external factors caused the significant increase in positive emotion for all of the participants, and more likely to be due to use of SmileTracker. However, the exact mechanism through which this increase occurred requires further research.

[2]The average time of day at which the surveys were completed was 4:40pm for the before survey, and 5:15pm for the after survey

Qualitative feedback
From the usability questionnaire we received a large volume of useful feedback which will be extremely valuable in designing the next iteration of SmileTracker. One of the prominent themes of the responses we received concerned privacy; some participants were hesitant or unwilling to use the app because of the sensitive nature of the data it records. We received comments like, "I'm not super enthusiastic about having a webcam recording my face all the time", and "I wasn't entirely sure that it wouldn't take a picture that I didn't want it to share". Therefore in the future we will make it more clear to participants that their data is completely under their own control and only they have the power to share it.

The feedback also indicated a need to streamline the process of setting up the system. While one user stated, "setting up Java rules was a one time thing and the guide helped out", others struggled. There were several complaints about having to enable the Java security exception, saying it was "a pain" or that "there were issues" with it. In the future, we intend to improve the transparency of the system by making it clearer to the user when the Java applet has not been enabled, and to include a tutorial on the website (as one user suggested).

The effectiveness of the smile detection algorithm varied between participants. While some commented, "the SmileTracker algorithm worked very well for me", and "[it] detects smiles just fine", difficulties with lighting, glasses, and facial hair were reported. For example, "It struggled with bad lighting and my face never seemed to get a high smile rating", and "It seemed to not register the smile as

easily now that I have a beard". We believe that introducing the adaptive and customizable smile thresholds helped to alleviate these problems. This assumption was corroborated by a user who stated, "I think the manual bar made it work".

While the feedback provided valuable insight into how to improve our prototype, we also found that users liked the overall concept and design, commenting "Reviewing your smiles and screenshots side by side is very easy", "The gallery is nice", "I liked how it was kinda self explanitory what it was supposed to do", and "Nice user interface". Several users stated that the screenshots were the aspect of SmileTracker that they liked most, explaining that the automatic nature of the screenshots was beneficial because they would not normally think to take the photo themselves. In general, SmileTracker was well received, with participants commenting, "It's a cool idea", and "the general concept behind it is pretty ingenious".

Conclusions and future directions

Despite the fledgling nature of our prototype, we have discovered that there is a demand for this application. Further, our initial study showed a significant increase in positive affect after using the app, which could suggest that SmileTracker does in fact help to promote positive emotion; this claim will need to be further investigated in future work. We also intend to make a number of improvements based on the feedback we received, placing particular emphasis on streamlining the process for setting up the Java applet and improving the robustness of the smile detection algorithm. Given the goal of this project is to improve wellbeing, the potential benefits that the collected data could provide are numerous. Not only could we help participants track and monitor their positive emotion over time, but by automatically analyzing screenshot content in relation to the intensity and number of smiles, we could infer relationships between users' computer use behaviours (including social and work patterns) and their emotional wellbeing.

Acknowledgements

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