

# SenseGlass: Using Google Glass to Sense Daily Emotions

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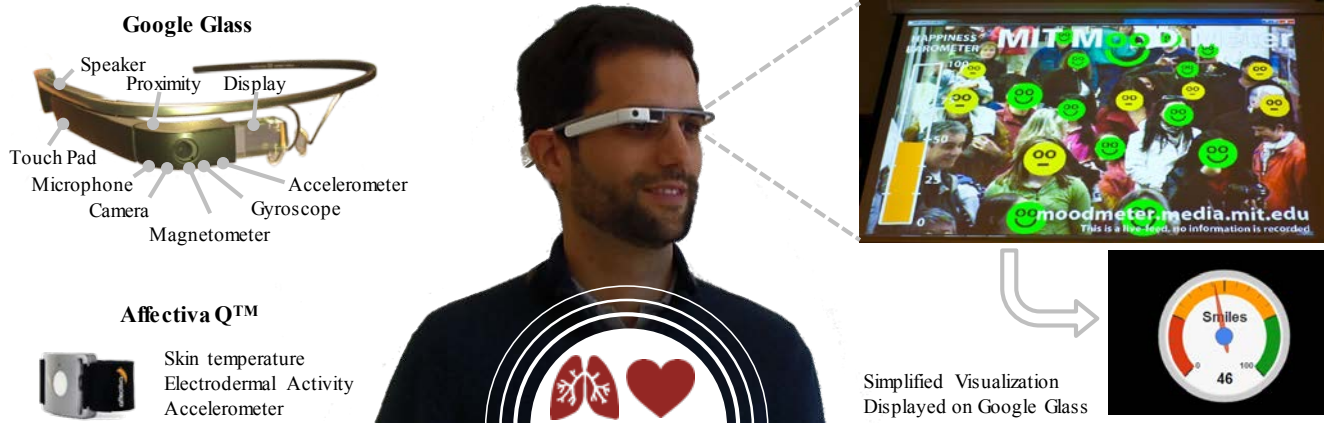


Figure 1. Sensors of Google Glass and wearable devices can help measure and visualize daily life emotions.

## ABSTRACT

For over a century, scientists have studied human emotions in laboratory settings. However, these emotions have been largely contrived – elicited by movies or fake “lab” stimuli, which tend not to matter to the participants in the studies, at least not compared with events in their real life. This work explores the utility of Google Glass, a head-mounted wearable device, to enable fundamental advances in the creation of affect-based user interfaces in natural settings.

## INTRODUCTION

Emotions play a very important role in our daily life. They not only help regulate important processes such as memory acquisition, attention and engagement, but also are fundamental to achieve successful social interactions. In order to create more natural and human-like interactions, researchers have focused on the creation of user interfaces that can measure and adapt to human emotions [4]. While most of the progress has been limited to controlled laboratory settings where emotions are easier to study, measuring and adapting to emotions during natural settings

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remains very difficult due to many challenges (e.g., uncomfortable sensors, unreliable ground truth data, uncontrolled environment) [5]. This work explores how Google Glass can help address some of the main challenges in the measurement, recognition and adaptation of real-life emotions, enabling fundamental advances for the creation of affect-based user interfaces in natural settings.

## Affect Sensing

Google Glass (*Google Inc.*) is a commercial head-mounted wearable device equipped with several sensors (e.g., accelerometer, camera), connectivity capabilities (e.g., Bluetooth, WiFi), and a see-through display (see Figure 1). The device is designed to be worn like a pair of glasses, enabling gathering personal information of the wearer during daily activity. In a recent exploration [3], we have shown that motion sensitive sensors such as the accelerometer embedded in Glass can accurately capture subtle head motions due to the beating of the heart and respiration of the person, enabling comfortable measurement during sedentary activities in an office.

Glass can also be connected with existing state-of-the-art wearable devices that can comfortably monitor other relevant physiological signals. For instance, we have created a custom-made Android program that connects Glass with the Q™ sensor (*Affectiva Inc.*) through Bluetooth and enables continuous measurement and visualization of the captured data. Being able to wirelessly collect different physiological parameters and have them automatically synchronized with the same device is critical for the understanding of emotions during natural settings.

## Emotion Recognition

Once physiological data have been collected, learning methods need to be applied to infer the emotional states. When applying these methods, two critical challenges need to be addressed: obtaining reliable emotional ground truth and capturing the variability of natural settings.

To address the first challenge, researchers traditionally request people to self-report their emotional levels on the phone [5]. However, participants do not always hear phone notifications and/or find the process of fetching the phone slow and emotionally disruptive. Due to the convenient location of the Glass see-through display and the multi touchpad, participants can be more aware about the notifications and reduce the reporting time, yielding more frequent and reliable emotional ground truth data.

Another critical challenge is the large variability and unpredictability of natural settings where many different events can yield similar physiological responses. For example, several kinds of activities – physical, emotional, and cognitive, can elicit physiological stress and across some channels of measurement the stress signatures may look the same. In order to clearly disambiguate the source of the physiological responses, contextual information is needed. Some of our previous work has explored how cellphone data such as GPS, Bluetooth, calendar and caller activity logs can provide rich contextual information for stress measurement and reflection [1]. We have also explored the possibility of capturing rich visual context with a phone hanging from the neck [2], offering the possibility of not only capturing relevant features such as the number of people in front of the camera, but also their emotional responses. Knowing the dynamics of how those faces are smiling or not, for instance, can help discriminate between positive and negative situations. As Glass is equipped with all the previous sensors, it enables capturing a wide gamut of insightful contextual information. In order to start exploring some of the possibilities, we connected Glass with custom-made smile recognition software [1], allowing real-time detection, counting, and visualization of surrounding smiles (see right of Figure 1).

## Visualizing and Adapting to Emotions

The form factor of Glass enables unobtrusive real-time visualization of affective information, which can potentially empower the wearers to change their behavior and better influence certain emotional states. When displaying the average intensity of the smiles of people, for example, users can increase their awareness and provide more control over certain situations. For instance, during a public speaking scenario, the speaker may not be able to look at every face of the audience. However, by displaying aggregated metrics such as the average intensity of smile on the see-through display, the speaker could know when the audience is losing engagement and appropriately modify the speech. Similarly, people with visual impairments and/or nonverbal expression interpretation challenges could benefit from

real-time technologies to help them sense the emotional responses of others and reduce the uncertainty and stress associated with social interactions.

Capturing and processing continuous affective information in real-time also enables providing timely and gentle emotion management interventions. For instance, Glass is able to display a breathing guide (a line that rises and falls, slowly, guiding the user towards deep in- and out-breaths), once the sensor detects increased levels of relaxation, the display can fade away. This intervention is very similar to traditional biofeedback exercises, which are widely used for emotion regulation. However, Glass offers the possibility of comfortably and unobtrusively delivering the intervention when most needed, *in situ*, for example when dealing with computer problems that pop up during paper deadlines.

## CONCLUSIONS

Combining state-of-the-art biosensors with Google Glass technology promises to advance the creation of affect-based user interfaces. We have started building prototypes and feel obligated to also mention limiting factors. For instance, battery and storage space highly constraint the sensors that can be simultaneously recorded. Furthermore, important privacy concerns are raised when monitoring information of others and/or transmitting affective information over the wireless. Our research has begun exploring the potential implications of such technologies and is performing research studies that quantitatively and qualitatively analyze the advantages and limitations of such approaches.

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