Abstract
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The Emotional Economy for the Augmented Human

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ABSTRACT
Happiness research findings are increasingly being taken into account in standard economics. However, most findings are based on a posteriori surveys trying to infer how happy people have been. In this paper, we argue that the advances in wearable computing, especially brain-computer interfaces, can lead to real-time measurements of happiness. We then propose a new kind of economy model where people pay depending on the emotions they have experienced. We have combined current commercial-on-the-shelf software and hardware components to create a proof-of-concept of the model.

Categories and Subject Descriptors

General Terms
Economics, Experimentation, Human Factors.

Keywords
Brain-computer interface, economics, emotions.

1. INTRODUCTION
“Happiness is generally considered an ultimate goal of life” [1]. In this paper, we investigate how new Commercial-On-The-Shelf (COTS) Brain-Computer Interfaces (BCI) can be used to provide real-time happiness feedback as people live their life. As that feedback is available in real-time, we then describe a model of economy, the Emotional Economy (EE), where people pay depending on the emotion they have experienced. We have combined COTS software and hardware components to give a proof-of-concept of the model in one main scenario: automated Facebook-like of Facebook video content, where the video owner is automatically rewarded by a Facebook like. Furthermore, we envision longer-term scenarios where the EE model could be applied: for example, organized tourism tour, where the price of the travel depends on the positive and negative emotions experienced during the organized tour.

We discuss related work in Section 2. Section 3 describes our EE initial model. Section 4 shows how we have implemented and given a proof-of-concept of this model with a combination of currently available COTS components. We conclude in Section 5.

2. Related Work
Happiness research [1] starts by collecting information useful to measure how good life is and then learns how it can be maximized, for example, through new government policies such as the new ones investigated by the French government in a recent report lead by international experts [2]. However, most collection of information is made a posteriori, late after people have experienced their day-to-day emotions, and only through surveys [3]. In our model, we leverage wearable computing as much as possible in order to obtain more accurate real-time information about the happiness experienced by the users.

BCI research has started in the 1970s [4]. Nowadays a few startup companies have taken the challenge to produce affordable and user-friendly BCIs [5]. Our work does not concern improving BCI but using COTS BCI as one of the means for feeding our model with more accurate real-time information about the happiness experienced by the users.

There are also other wearable computing sensors that can be used independently or combined together to detect the user’s current emotion. For example, the StartupCam wearable system [6] monitors the wearer’s skin conductivity and when a pattern is detected, the camera worn by the user records the current situation on a remote server. Another example of lifelog detection is Aizawa et al.’s one [7] that combines acceleration, gyro and GPS sensors and focuses on methods for efficient retrieval of information based on context and content. These other wearable sensors would improve the emotion detection step in our model.

However, our model goes beyond merely technical contributions for detecting and storing the user’s emotion and what triggered this emotion because it reuses that information in a follow-up economy model. That economy model involves not only the user itself in a short-term scenario perspective but also all the users in the long-term when it may come to define country-level economy policies based on all users monitored level of happiness throughout the year.

3. The Emotional Economy (EE) Model
We envision an economy where people are augmented with wearable computing sensors able to detect user’s emotions, for example BCIs, and pay more or less for services according to the happiness they have experienced thanks to these services. The duration of the experience may vary. For example, it may be the duration of an online comedy video that the user has watched.
In this initial EE model, we also assume that:

- the service is not perturbed by external factors, which could otherwise in real life modify the user's emotional state independently of the service
- all users have the same emotional profile, for example, it requires the same amount of effort to make someone laughing

In real life, as all users do not have the same emotional profile, the provider would have to customize the threshold levels and the associated emotional costs according to the emotional profile of the user. An emotional cost may also be negative, for example, if the user reaches a high level of frustration emotion.

4. EE MODEL PROOF-OF-CONCEPT

The previous section underlines that a number of service scenarios with different durations are of interest. In this section we first present how we have combined different COTS components to build our proof-of-concept. Then we detail the Facebook auto-like scenario and the organized tourism tour scenario.

4.1 COTS Components Combination

We have chosen to use the Emotiv EPOC BCI [8] because it provides a software development kit (SDK) and a higher number of sensors than its current competitors.

At time of writing, one Emotiv BCI headset costs around 500 dollars. The headset is provided with a USB wireless connector, which is easier for our second scenario that requires carrying a laptop. The headset battery life is also good for this scenario because it lasts around 12 hours. The headset is quite easy to set up and use: it is just required to wet the sensors with saline solution. However, as the headset may move during activities and get disconnected, it is not yet perfect for long-term daily tests that do not bother the users in their daily activities.

Concerning the SDK, the BCI comes with a handy EmoKey Windows application that is able to transform the headset emotion signals when they have reached a threshold between 0 and 1 into keystrokes that can be forwarded to other Windows applications. In our case, a Java application was coded to be able to receive those keystrokes and forward them to other Java pieces of our proof-of-concept as depicted in the following Figure 1.

Figure 1. Emotiv SDK connected to our Java bridge
We mapped each detectable Emotiv emotion to our emotion types in our EE model. Therefore the following emotion types are available in our proof-of-concept:

- Engagement
- Frustration
- Meditation
- Instantaneous Excitement
- Long Term Excitement
- Happiness (that we have mapped to the Emotiv laugh detection)

### 4.2 Automatic Facebook-like Scenario

As depicted in Figure 2, this scenario consists of automatically sending a Facebook like when a user is watching a Facebook video and the BCI detects the Happiness emotion.

Two other Java applications had to be coded: the first one in order to let the user connect to Facebook and send a Facebook-like on behalf of the user; the second to act as a Web proxy to know which Facebook video is being watched by the user. When the first application detects the Happiness emotion then it asks the second application which video is being watched and sends a Facebook-like of the video to the user’s Facebook account. That Facebook-like corresponds to the cost reward for the video provider in our EE model.

![Figure 2. Automatic Facebook-like Scenario](image)

The sequence of actions is as follows:

1. The video is fetched via our Java Web proxy
2. Our Java Web proxy returns the video to the user’s Web browser (Firefox, Chrome…), which is configured with our Java Web proxy
3. The Happiness emotion is detected by the SDK
4. The EmoKey informs our Java Bridge that the Happiness emotion has been detected
5. Our Java Bridge informs our Java Facebook Proxy that the Happiness emotion has been detected
6. Our Java Facebook Proxy asks our Java Web Proxy which is the current Facebook video being watched
7. Our Java Facebook Proxy automatically sends a Facebook-like about the video to the Facebook user’s account because the user has initially connected our Java Facebook Proxy to her/his account

### 4.3 Organized Tourism Tour Scenario

This section describes a longer duration scenario, which is also mobile. As already mentioned the Emotiv headset can last around 12 hours and in this scenario is wirelessly connected to a laptop that is carried by the user as depicted in Figure 3.

In addition to our Java Bridge, another Java application continuously logs the time and GPS location of the user from the start of her/his tourism tour to the end. It also logs the time of emotion detection events that are higher than the configured thresholds. In this scenario, we have set up all thresholds to 0.5 and record the events as they happen. It is then possible to see where they have happened on a Google map that shows the track of the tourism tour.

![Figure 3. Organized Tourism Tour Scenario](image)

If the Long Term Excitement emotion is still on at the end of the tour, it is a case where our model should be extended to take into account positive emotions that last beyond the service has ended. Frustration is clearly a negative emotion that would require a negative cost according to our model. Such a scenario would be...
useful for automatic touristic reviews of the places that have been visited. For example, if a lot of frustration is detected when being in a restaurant visited during the tour then it may be an indication that the user was frustrated about the restaurant service. If that evidence is supported by a negative review submitted with the mobile of the user to an online restaurant service then it is another evidence that the user has clearly had a bad experience in this restaurant. Current online rating services have a good number of malicious reports and evidence from BCI may help detecting those malicious reports.

5. CONCLUSION

In this paper we have proposed a new model of economy based on the emotions that the users experience detected with wearable computing sensors, such as brain-computer interfaces. Although such interfaces are not yet available on the mass market, we have given a proof-of-concept of our model with current commercial-on-the-shelf components. Concerning the longer term scenario evaluating the happiness of users during a full year, besides simulating it economically on a larger scale, we are looking for setting up a bigger project in different countries with a statistically sound number of testers to compare which economy policies, cultures and living environments maximize happiness. However, for this long term scenario, a new combination of the wearable sensors mentioned in the related work would have to be found since it is not yet easy enough to wear an Emotiv BCI in daily life. Such a project should bring valuable new insights for happiness researchers who have just used a posteriori surveys so far.

6. REFERENCES


