

Beyond ‘Happy Apps’: Using the Internet of Things to Support Emotional Health

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Abstract. Emotions and physical health are strongly related. A first step towards emotional well-being is to monitor, understand and reflect upon one’s feelings and emotions. A number of personal emotion-tracking applications are available today. In this paper we describe an examination of these applications which indicates that many of the applications do not provide sufficient support for monitoring a full spectrum of emotional data or for analyzing or using the data that is provided. To design applications that better support emotional well-being, the full capabilities of the Internet of Things should be utilized. The paper concludes with a description of how Internet of Things technologies can enable the development of systems that can more accurately capture emotional data and support personal learning in the area of emotional health.

Keywords: Internet of Things · Emotion · Emotion-tracking applications

1 Introduction

Very little research has been conducted on the extension of Internet of Things (IOT) systems to include emotion detection. Similar to how wearable health tracking devices connected to the IOT can track physical metrics such as steps and heart rate for personal use or in a healthcare context, data relating to emotions can also be tracked using wearable devices, mobile applications, and other sensors as part of the IOT.

Emotions influence health both directly (through physiological responses) and indirectly through changes in decisions and behavior [1, 2]. Although the majority of studies on emotions and health have been focused on cardiovascular disease, indicating that individuals who can better regulate emotions are at a significantly lowered risk for heart disease [3], there is growing recognition of a more general relationship between emotions and health [4].

Emotions are complex states, which have neurological, physiological, cognitive, and behavioral aspects [5]. Emotion-detecting applications have been developed to sense emotion through voice patterns, facial expressions, physiological sensors (ECG), and brain wave sensors (EEG). While acknowledging the complex nature of emotion, some researchers believe that the best way to determine what an individual experiencing an emotion actually feels is to use self-reporting [6]. That approach is what we see in the personal emotion tracking applications available today.

To understand how personal tracking of emotions is currently enabled and how the results are used, we examined consumer-focused, personal emotion-tracking applications. To structure the evaluation, a framework developed to compare personal informatics applications was used [7]. Following this assessment of the current state of emotion-tracking applications, we discuss additional considerations that should be addressed in the design of IOT systems that address emotional well-being. The paper concludes with a discussion of implications for the design and development of emotion-sensing IOT systems and identification of areas that are particularly in need of additional research.

2 Analysis of Self-reporting Emotion Apps

To explore existing consumer applications that support self-reporting of emotions, keywords “happiness”, “emotions”, “mood”, “mood tracker”, and “feelings” were used to search for apps on Google Play and the App Store. In addition, we searched forums on the internet where various types of emotion apps were discussed. The selection criteria was for the application to have as its primary function the ability to track and individually reflect on emotions. (This excluded, for example, applications used to track mood as a way of predicting menstrual cycles.)

The search resulted in 92 apps of which 34 were disregarded because they did not work, required the login associated with a therapy group, turned out not to have emotion tracking as a primary task or were no longer available. (A complete list of the applications can be obtained from the authors.) Only one app worked with a separate hardware sensor (galvanic skin response) but the sensor is no longer available for purchase so the app was therefore not included in the analysis. It is interesting to note that very few (only about 30%) of the developers of the applications in this study claim to be grounded in psychological research or practice.

The remaining 57 apps were installed and analysed according to Ohlin et al.’s [7] classification system which includes a total of 9 dimensions on which to evaluate the applications: (1) selection of data to collect, (2) temporality of collection, (3) support during manual entry, (4) data collection control, (5) form of goal setting, (6) data analysis control, (7) form of comparison, (8) subject(s) of comparison and (9) appraisal. The dimensions can be viewed from the perspective of the type of support provided, and this more parsimonious structure will be used to frame our evaluation of emotion-tracking applications. Collection support deals with how to support the user to collect data (dimensions 1–4), while procedural support is about how the app supports users in their daily use of the app such as by providing notifications to collect data and by providing encouragement (dimensions 4–7). The third type of support, analysis support, is about how the users can be supported when analysing and reflecting on the data (dimension 6–9).

2.1 Collection Support

Collection support refers to how data is collected and how the collection is made easier for the users. In most of the apps there are predefined emotions to choose from in form of symbols and/or words. In some of the apps it is possible to make a selection of a subset of emotions to use for reporting. Half of the apps also allow for user defined data through adding free text to describe a feeling. A few apps allow for more customization, for example T2 Mood tracker and InFlow.

As mentioned only one of the apps originally identified, EMet – emotional meter, has support for hardware sensors that could collect emotions continuously. However this sensor is no longer available so the application was not included in the analysis. All the other apps collect emotion data as single entries by the users. Only one quarter of the apps analysed allow the user to edit a previous entry.

To represent emotions most of the apps use emoji of different kinds. A couple of the apps use an affect grid [8] where you position your emotion in one of four quadrants depending on whether you feel a pleasant or unpleasant feeling in combination with high or low arousal.

As the apps rely on solely self-reporting, the users need to be reminded to record an emotion. Surprisingly, less than half of the apps contains some kind of notification. How the user is notified or prompted varies. Most of the reminders are simple notifications in the mobile phone's notification field. Some apps use widgets that are activated and prompt the users to record their emotions when opening the phone. It is in many cases possible to tailor when the notification should show up. Only four apps use random notifications.

What we can learn from the analysis of the apps in terms of data collection support is that it is important to represent emotions in a way the individual user finds appropriate. The representation must be nuanced and reflect the user's emotion. A customizable combination of words and symbols might be a good way to move forward. Another aspect to consider is how the representation of the emotions may evolve in line with the user's understanding of their own emotions.

2.2 Procedural Support

Procedural support assists in the daily use of the application, aiding in integrating the application with the user's lifestyle and achieving desired outcomes. In their evaluation of general apps for personal informatics (PI), Ohlin et al. [7] identified procedural support as generally underdeveloped. The same can be said for emotion-tracking apps. There are only a few attempts to combine activities with emotion tracking. For example Activity Mood Tracker makes the user track her emotion before and after a pleasant activity to make the user reflect on the potential change.

Goal setting is considered important in PI, but in the emotion apps goals are sparsely considered. Moodlytics makes an attempt by letting the user choose a goal for how long she wants to be happy every day. This kind of goal is very crude in the context of emotions where it could potentially lead to a more negative state if the goal is not achieved.

When it comes to data analysis control none of the apps try to prompt the user to look back at the reported values. It is completely up to the user if and when to reflect on the reported emotions.

It is common in PI to compare the results with self and others. In emotion apps it is mainly oneself that is the subject of comparison. An exception is Emotion Sense. In Emotion Sense the user has to answer a set of questions that are evaluated and compared to statistics about the general population.

Rather than setting goals as quantifiable measures, there may be better ways to direct emotion-related activities such as through describing an overall ambition or desired state. The notifications that exist in the reviewed apps are rather blunt. A more context-aware approach to providing notifications should be considered. In addition the users should be prompted to reflect on the day to be able to learn what made them feel like they did.

2.3 Analysis Support

Analysis support is neglected in most of the apps. The apps display the data in different ways and in different historical time spans or in calendars, but there is not any support to interpret the data and guide the user as to what the data may mean. As mentioned above, Emotion Sense interprets a set of questions and presents it as insight of who you are, but there is no transparency of how this is done which both leads to a lack of trust and prevents learning from it.

Sharing data with friends or therapists is quite common in these emotion-tracking applications. This can be done in different ways and with different mediums such as e-mail, Twitter, Facebook etc. Most of the interaction and appraisal take place outside of the app. MoodPanda has taken another direction and has an internal forum where users can respond to other users' emotions and give them a virtual hug.

The take away regarding analysis support is that there is a need to visualize a bigger picture where the user's emotions are put in context, possibly by comparing with other users in a clever, non-critical way. There is also a need to help the user interpret the data. The ability to share the data, if desired, to receive social support is another important aspect of these applications.

3 Additional Considerations for Emotion-Sensing Apps

The same types of metrics, tracking, and support structures cannot be taken directly from personal informatics applications and applied without modification to emotion tracking applications. There are several significant differences between 'emotion management' and typical personal informatics (also called quantified self) applications. Three of these – levels of abstraction, ethical issues, and goal setting – are discussed below.

3.1 Levels of Abstraction in Measuring Emotion

When evaluating emotion, we are not attempting to capture just one measurable physiological state such as heart rate or one value captured by sensors on a device. Emotion involves a range of responses from the neurobiological to the behavioral. The context and other factors specific to the individual may influence the subjective feeling of the emotion experienced. Thus an individual's emotional state at any particular moment reflects and is influenced by a broad range of factors. To truly capture an emotional state, it may be necessary to combine neurological, physiological, and contextual data on an on-going basis. Environmental factors such as traffic, temperature and noise level may contribute to an individual's emotional state. Location of the user, the proximity of others, and life events and activities may influence emotion. A simple periodic self-reporting of emotional state may be useful in tracking how the user feels over time, but does not address the deeper issues of contributing factors, which may be necessary to measure as well to provide a complete picture and determine appropriate actions to take to rectify a problem or make a change in order to improve overall health.

3.2 Privacy and Ethical Issues in Measuring Emotion

While there are certainly privacy issues surrounding the capture and use of typical personal informatics data such as location and activity level, the risk to the individual is potentially much greater when we consider capturing data regarding emotional state. One area is the ability of marketers to target potential customers at a deeply personal and more vulnerable level. The risk of mis-use of emotion data to manipulate actions seems to be greater than with other personal tracking metrics.

3.3 Goal Setting for Emotions

Another significant difference between personal informatics health tracking systems and emotion tracking systems is in the area of goal setting. If an individual wants to lose weight, for example, it is relatively easy to monitor the two primary components: input of calories and amount of exercise. If an individual wants to be happier, it is not clear that there are general quantifiable goals that can be tracked to help meet this objective. A more context-specific and personalized strategy is needed in order to support the user to achieve her/his objectives.

It is likely that the strategies necessary to achieve desired changes in emotion [1] will be more complex than those needed to change more straightforward health behaviors. Transparency in thoroughly explaining any decisions regarding recommendations would be essential to establish the level of trust that would support such major initiatives.

4 Conclusion

This paper has provided a very high-level overview of emotion tracking applications. It is not possible here to provide a thorough discussion of research linking emotion tracking and health or an in-depth description of the various technologies that support

emotion tracking. Our examination of existing emotion-tracking applications provides a baseline from which to move forward in designing applications that support health through self-tracking of emotions. While there are useful features in some of these apps, such as the ability to customize the particular data that is recorded and to reach out to social networks, much more functionality is needed and is in fact possible with today's IOT technology. We have sensors that can measure biological and neurological responses and states continuously, and these can become part of future IOT emotion-management systems. Via our context-aware IOT networks we can collect data on a broad array of environmental factors that may influence stress, emotions, and the ability to respond to them to allow us to design applications that can be not only context-aware but also emotion-aware.

Additional research is needed to determine the appropriateness of goal setting in the area of emotional health, and perhaps to find other means to support individuals who are striving to change their emotional state or response. In addition, tools will be needed to support the tracking and reporting of emotion data to aid users in the appropriate interpretation of the data and to create self-learning environments where not only can users measure their emotional states, but can also determine the best individualized means to achieve positive results.

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