

Collaborative, Context-aware Experience Sampling for Depressive Patients

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Abstract. We propose a collaborative, context-aware, and multi-modal experience sampling method called CoESM to record experience samples of depressed patients. The CoESM utilizes location and activity sensors on a mobile device to detect a depressed patient's physical and social activity levels. We hope that through collaboration, context-awareness, and multi-modality input, the CoESM can help a psychologist gain better understanding of patients.

Keywords: cognitive psychopathological, interpersonal context, depressive symptoms, context-aware, collaborative, multi-modal.

1 Introduction

Suicide resulted from depression is one of the major causes of death among young adults in the U.S. [1] and Taiwan [2]. Statistics have been showing a rising trend in recent decades. In this work, we would like to explore ubiquitous computing technologies for depression treatment. Often used in conjunction with medicine, an effective approach to treat depression is psychotherapy. The key to conduct an effective psychotherapy is to identify the causes of depression in advance, which is a challenging task. Since the causes of depression can span through biological, psychological, and social aspects, depression is often characterized by patients experiencing in thick and dark fog. In order to identify the potential causes of depression, psychologists have to peel off the layers of patients' lives.

In the cognitive psychopathological model of depression, one's inner cognitions affect his/her interpretation of the encountering event, which is often characterized by interpersonal context. These maladaptive cognitions may result in negative mood and depressive symptoms [3]. The interaction between the depressed patient and his/her significant other is one of most common triggering event, and can contribute to the development of his/her depression. It is thus essential for clinical psychologists to accurately identify the triggering events and corresponding cognitions and emotions.

In practice, there are many methods psychologists can utilize to identify the causes of depression. In a traditional method, psychologists talk to depressed patients in a room, asking them to recall what have been happening to induce depressive symptoms. Then, they analyze the responses to figure out the activating events and inner cognitions. However, asking patients to recall past experience is prone to recall error and memory bias. Experience sampling, on the other hand, aims to address this memory bias problem by sampling patients' daily fluctuation of thought, mood, and symptoms in their natural living/working environments. In particular, patients are asked to write down their experience on the activating events and inner cognitions in context, which is called a paper-and-pen based experience sampling method (ESM). In practice, patients have a booklet of questionnaires and a beeper, and they are signaled to fill a copy of questionnaires every now and then following a pre-set random schedule. For example, patients are asked to describe their mood status, what events (activities) have been happening, who was involving in the event, when, and where.

2 Ubicomp Opportunities

Although the traditional paper-and-pen ESM can minimize recall error and memory bias, there exist several limitations described as follows. First, in order for a psychologist to explore different possible activating events, he/she asks patients to write down experiences immediately after encountering these events. However, after being emotionally upset from these events, depressed patients often forget to record such experiences. This brings up an opportunity for *context-aware technology* that can detect events, location, and provide a timely reminder to prompt the patients to record experiences.

Second, some patients may often enter into emotional downturns and become mentally incapable of filling written surveys. For example, some patients often find themselves too weak to get out a bed to fill surveys. However, for both psychologists and patients, these weak moments of emotional downturns may bring valuable insights for discussion of a coping strategy. This brings up an opportunity for *collaborative technology*, in which the patients' caregivers, i.e., family and friends, can provide their first-hand observations after interacting with the patients. The perspectives from caregivers are good supplement to the often *subjective emotion expression* from patients, and can aid the attending psychologist with better understanding of patients.

Third, some severely depressed patients may lack mental initiation to respond to written questionnaires, but can still verbally reply to questionnaires. This brings up an opportunity for *multi-modality*, in which the ESM technology can adapt to the preferred input modality choice for patients.

3 Proposed Design & Implementation

Our proposed experience sampling tool is *context-aware, collaborative, multi-modal, and in-situ*. This collaborative, context-aware experience sampling tool (called *Co-*

ESM) is developed on a mobile device, such as a cell phone, equipped with location (i.e., a GPS receiver) and activity (e.g., an accelerometer) sensors. From this mobile device, CoESM collects experience samples by delivering and prompting questionnaires to patients. Conditions to trigger questionnaires are dynamic and context-dependent. This enables an inquiring psychologist to specify conditions matching potential activating events of interests. When a patient completes a questionnaire, CoESM automatically logs a timestamp, and records the current context such as location, physical and social activity level.

CoESM is *collaborative*. It enables caregivers (i.e., family and friends) to participate in recording patients' experience after they have had a face-to-face contact with patients. To detect a face-to-face contact, a patient's phone periodically scans any nearby phone via Bluetooth. If a nearby phone belongs to a known participating caregiver, a questionnaire is delivered to the caregiver's phone through SMS messaging.

CoESM supports *multi-modality*. Patients are not only able to respond to written questionnaires with the keypad and stylus on a phone, but can also use a phone's microphone for natural voice input.

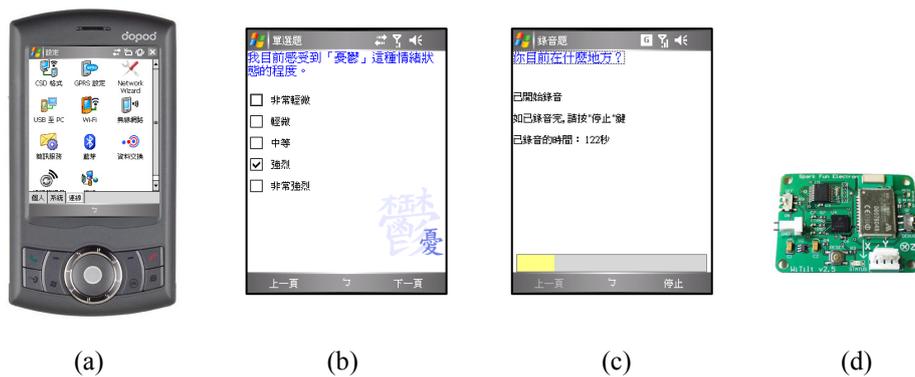


Figure 1: (a) Dopod p800w PDA phone, (b) Prompted questionnaire of CoESM in Chinese, translating into English is “please indicate to what extent you feel right now”, (c) Voice recording screenshot, (d) Bluetooth wireless accelerometer from SparkFun

Our preliminary prototype uses the Dopod p800w PDA phone as shown in Figure 1(a). It has a built-in GPS receiver, a built-in Bluetooth radio, and an attached wireless accelerometer from SparkFun (for detecting a patient's activity level). Screenshots of the questionnaire on the PDA phone is shown in Figure 1(b),(c). After completing the questionnaires, participants' replies will be uploaded to a secure server and made accessible only to authorized psychologists.

4 Conclusion and Future Work

In this work, we propose CoESM, which is a context-aware, collaborative, and multi-modal experience sampling tool to record experience samples of depression patients. There are several related Ubicomp projects on experience sampling methods. The context-aware experience sampling (CAES) tool [7] utilizes environmental sensors and biosensors to trigger sample collection based on specific circumstances. iESP [5] and MyExperience[6] adapt sensors into their experience sampling tools to help evaluate how users interact with mobile devices and applications. MyExperience and iESP focus on feedbacks from a single user, whereas CoESM collects feedbacks from multiple users, not only from patients but also from caregivers. These collective feedbacks are expected to provide better understanding of social support and relations between depressive patients and their significant others.

For our future work, we will prototype the CoESM tool and conduct evaluation on patients. Our research questions are: Are depression patients willing to accept and use this context-aware tool in recording their daily experiences? Does multi-modality input help patients express their emotions more easily? Are patients willing to allow caregivers to collaboratively participate in their experience sampling? What frequency of triggering questionnaires will patients find annoying? Can we find a balance between frequent questionnaires and effectiveness of survey? Our future user study will help answer these questions.

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