A Phone-based Support System to Assist Alcohol Recovery

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Abstract
This study explores the use of mobile phones as a normal life support system that connects alcohol addict patients to their addiction physiatrists after they leave a rehabilitation center. This paper presents the design and implementation of this phone-based support system that enables continuous patient monitoring and provides feedback support to the patients.

Author Keywords
Persuasive technology; alcohol; health; storytelling;

ACM Classification Keywords
H.5.m. Information interfaces and presentation (e.g., HCI): Miscellaneous.

General Terms
Design; Human Factors;

Introduction
For alcoholic abuse patients, making it through a rehabilitation program is an achievement. However, returning to regular life and staying sober are often more challenging tasks. Studies [1] have shown that the relapse rates for alcohol patients three months after treatment are around 60%. To manage alcohol addiction, it is important to have a support system in

place after patients leave the rehabilitation center and return to regular life.

This study explores the use of mobile phones as a normal life support system that connects patients to their addiction physiatrists after they leave a rehabilitation center. This support system enables continuous patient monitoring and provides feedback support to the patients. For the monitoring function, the support system periodically prompts a patient to take Breath Alcohol Content (BrAC) tests (i.e., breathing into a Bluetooth alcohol gas sensor that detects alcohol consumption by measuring the alcohol concentration in the patient's breath). The sensor then sends the BrAC data to a database that is only accessible to the patient and his or her primary addiction physiatrist. For the feedback support function the support system provides a game to be played on the patient's mobile phone. Using the recorded BrAC data, the game visualizes the patient's progress in the struggle against alcohol. This game also introduces a social aspect of rehabilitation by enabling a group of alcohol addiction patients to share their progress and send encouraging messages to each other in an mutual attempt to maintain sobriety.

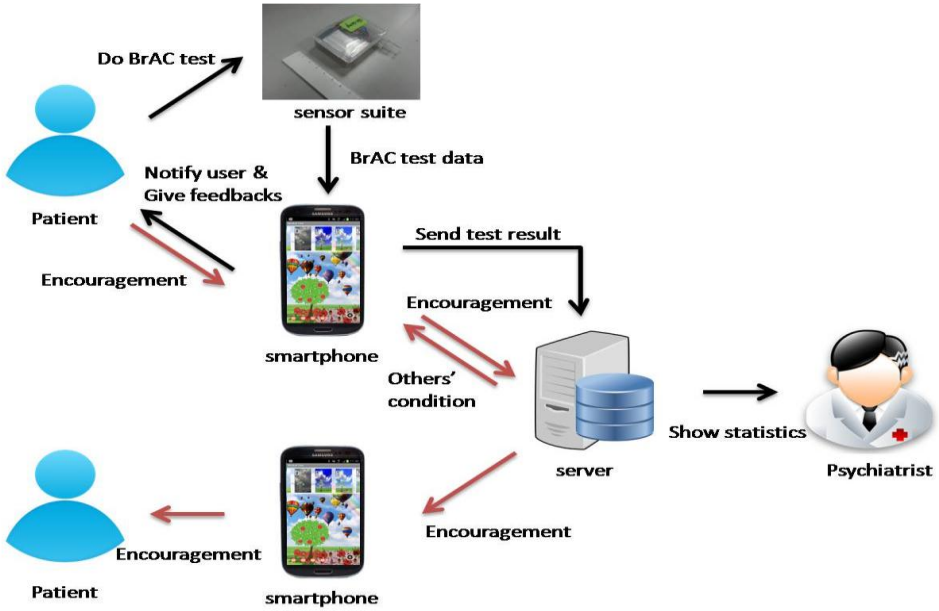

Figure 1: The system architecture. Black arrows represent the basic function of the system. Red arrows represent the interactive function of the system

System Design

Figure 1 shows the design of the proposed system, which consists of the following components: (1) the Bluetooth sensor unit, (2) the mobile application that contains the BrAC monitor and the feedback support game, and (3) the database server.

Bluetooth Sensor Unit

A patient receives a Bluetooth-enabled sensor unit that works as an off-phone sensor to measure the patient's BrAC. Figure 2 shows the sensor unit (size: 7 cm x 5 cm x 2.4 cm). The sensor unit contains a blow-in straw that collects an air sample from the patient's breath. This sensor unit also has a pressure sensor that detects the patient's blowing action. After the gas sensor measures the patient's BrAC value, a Bluetooth radio on the sensor unit sends the recorded data to the patient's mobile phone. A USB cable charges the battery of this sensor unit.

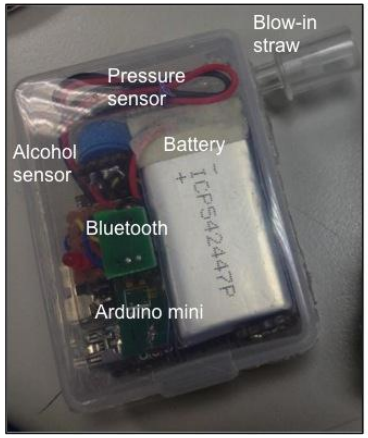

Figure 2: Sensor suite and main components. Note that the pressure sensor, Bluetooth and Arduino Mini are covered by battery.

Mobile Application

The patient downloads a mobile app that runs in the background on his/her phone. This mobile app has two main functions. The first one is a *BrAC monitor*, which periodically prompts the patient to take a breathing test using the sensor unit. A primary physiatrist can set the frequency of the BrAC test based on the patient's needs. One possible breathing test frequency is 4 times a day: once when the patient is taking medication after breakfast, once after lunch, once after dinner, and once more before bedtime.

Figure 3: BrAC test page.

Figure 3 shows a screenshot of the phone's screenshot when taking the BrAC test. A balloon in the middle of the screen visualizes the required length and strength of the patient's blowing action. To prevent cheating, we request that the patient perform the BrAC test in view of the phone's camera. The BrAC monitor turns on the phone's camera to take photos of the patient performing the BrAC test. These photos are uploaded with the BrAC test results to a database server that the primary physiatrist uses to verify that the patient is the one taking the BrAC test.

The second function of the mobile app is the feedback support game, described in the following section.

Feedback Support Game.

The goal of the feedback support game is twofold: (1) to visualize the progress and/or struggle of each patient in maintaining sobriety, and (2) to enable a group of peer patients (and addiction physiatrists) to encourage each other to overcome alcohol addiction together.

Figure 4 shows screenshots of the feedback support game played on each patient's phone. To visualize a patient's progress, the game adapts the simple metaphor of a virtual tree. This concept is easy for patients to understand because caring for a virtual tree is a metaphor for caring for the patient's body. When a patient ceases drinking and regularly passes phone-based BrAC tests, the virtual tree slowly transforms into a beautiful green tree while growing many apples. The virtual tree's background also improves to be a sunny, pleasant, and peaceful background. When a patient regularly misses and/or fails the phone-based BrAC tests, the virtual tree loses apples and withers. In this case, the virtual tree's background also deteriorates to an unpleasant, rainy, or even stormy background.

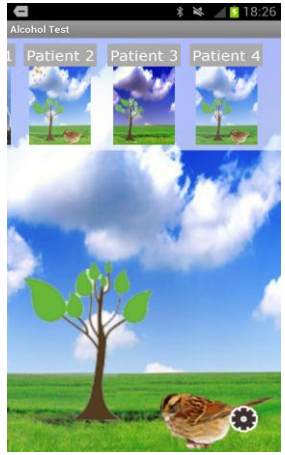

Figure 5: Screenshot of the feedback support game. The bar on the top shows group members' condition, and the background and the tree represent user's current condition

For peer encouragement, a patient can observe other patients' tree conditions, as shown on the top bar of figure 4. The goal of showing other patients' trees is to let them know that they are not alone in battling alcohol addiction. The game offers a short message service (by clicking on another person's virtual tree), enabling patients to motivate peers in their groups to stay away from alcohol.

Privacy and Personal Anonymity

Privacy and personal anonymity are both important and necessary to encourage patient participation. The fine-grained BrAC test results (e.g., the time and values of the BrAC tests) are kept strictly confidential and are only accessible to the patient and his/her addiction physiatrist. The virtual tree, which visualizes the coarse-grained progress of a patient, is only accessible to patients in the same peer group. To further protect personal anonymity, each patient can choose to show only a code name to the group. To form a peer group, one possibility is to draw patients who come from the same "graduating class" of a rehabilitation center. These patients already know each other through face-to-face contact in the rehabilitation center.

Storytelling

We are interested in exploring how to present or visualize a patient's progress in a storytelling setting. This would involve turning numerical BrAC test results into storytelling content such that patients can share "stories" about their struggle with alcohol addiction with their family and friends.

Database Server

The backend database server logs the time and values of the patients' BrAC tests as recorded by their phones. The database also records the patient's photos as proof that they actually took these breathalyzer tests. Only the patient's physiatrist has access to the patient's detailed records. Figure 5 shows the interface that the physiatrist sees when checking the progress of a patient. Each scheduled BrAC test is color-coded: red means that the patient failed the test, green means that the patient passed the test, and yellow means that the patient missed the test. Using this interface, a physiatrist can quickly grasp a patient's current status.

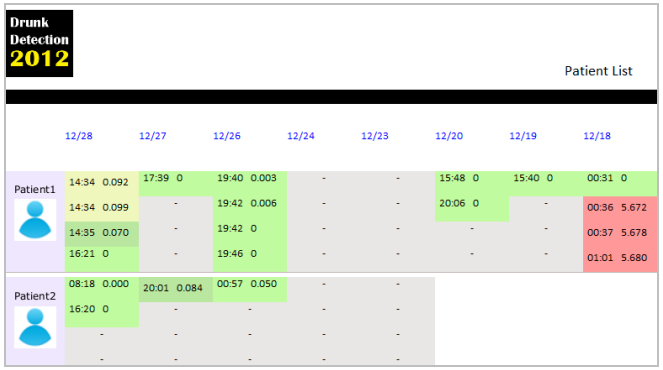

Figure 6: Screenshot of BrAC test results in backend server

If a patient agrees to have his/her location reported to the database server, the system uses the GPS/WiFi sensors on the phone to determine the patient's location at the time of taking (or missing) a prescheduled BrAC test. Location information provides useful contextual information that offers clues as to why a patient may have missed or failed a BrAC test.

Related Work

Researchers have recently developed numerous phone-based behavior-monitoring systems that leverage a smartphone and its built-in/off-phone sensors to detect human behavior. Examples include UbiGreen [2], UbiFit [3], Playful Bottle [4], and many others. Many of these systems also incorporate various elements of persuasive feedback to motivate human behavioral change. The proposed system belongs to the category of phone-based behavior monitoring and feedback systems. This study addresses a unique user population of alcohol-addicted patients and targets the difficult task of changing alcohol addiction behavior.

Conclusion & Future Work

This study presents a phone-based support system to help those with alcohol addiction to stay away from alcohol after leaving a rehabilitation center. A mobile application that runs in the background of each patient's phone periodically prompts the patient to take a BrAC test using a Bluetooth gas sensor. The sensor module sends the BrAC test results to a database that the patient's physiatrist can use to continuously monitor the patient's progress. The mobile application also contains a feedback support game in which patients can form groups to motivate each other to maintain sobriety together.

We are currently collaborating with addiction physiatrists in designing a real-world user study to test how well this phone-based support system works for alcohol addiction patients after their departure from a rehabilitation center.

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