
Got Sleep? : Mobile phone application to improve sleep

Akane Sano

Media Lab, Affective Computing
Group, Massachusetts Institute of
Technology
75 Amherst Street, Cambridge,
MA, 02134, USA
akanes@media.mit.edu

Abstract

Got sleep? is an android application to help people to be aware of their sleep-related behavioral patterns and tips about how they should change their behaviors to improve their sleep. The application evaluates people's sleep habits before they start using the app, tracks day and night behaviors and provides feedback about what kinds of behavior changes they should make and whether the improvement is done or not. In this paper, we propose our approach to intervene sleep.

Author Keywords

Sleep; Biological Rhythm; Biological Clock; Mobile phone; Android

ACM Classification Keywords

Measurement; Design; Experimentation

Introduction

Sleep is critical to a wide range of biological functions; insufficient sleep impacts a wide range of physiological functions. These include immune function, metabolic regulation [3], hormone regulation [7], and cognitive performance [4].

Unhealthy sleep behaviors are increasingly common in modern societies. One frequently cited main cause of this is the increasing use of electronic media, and

increased connectivity and socializing via social media. One of the main methods of communication is text messaging, and many of these interactions occur late at night, resulting in later bedtimes and disrupted sleep [2]. Recent data show that healthy and unhealthy sleep behaviors propagate between individuals connected by a social network. In addition, the social media itself may influence sleep through the light emitted by the devices; such relatively dim light at night has the capacity to delay sleep onset, suppress levels of the sleep promoting hormone melatonin and delays of the endogenous circadian biological clock [6] that promotes sleep and wake at certain times, thereby making it more difficult to fall asleep at the desired time. In addition, excessive internet and mobile phone use can cause anxiety and insomnia, and in the long term these effects can potentially lead to depression [10].

Previous Work

Many researchers have worked on sleep intervention. Sleep education also helps people to understand the importance of sleep and has been tested and measured its effect over various populations [12]. Online sleep training or therapy system has also been developed [9]. Less engagement has been pointed out in online therapeutic system than taking therapy in person. Using technology, home sleep monitoring system can tell users how long and how well they sleep with an accelerometer on smart phones or wearable devices. Lullaby is a system to monitor sleep and bedroom environment (light, audio, temperature and motion on the bed) [5]. ShutEye is a mobile phone application to track user's behaviors affecting sleep and provide recommendation to improve their behaviors [1]. Mobile phones which users carry with them most of the time, can send messages to users promptly and could make

users engaged with the system. In addition, smart phones have many kinds of sensors which can monitor user's behaviors and environment. One of the important factors in intervention is how we can engage users and make them stay using the technology for a long time. Also, playfulness can be also the important factor in the system. Gamification has been considered as important roles to encourage people to change behaviors or keep using technology for a long term.

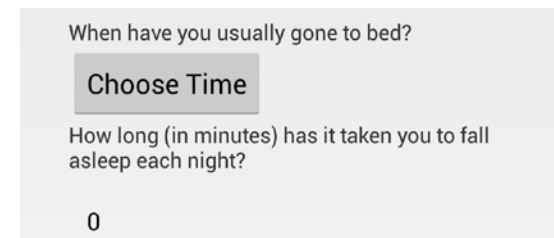
We propose a system to monitor user's behaviors and environment, collect subjective and objective measures about sleep, health, mood and performance and provide personalized feedback to encourage users to change their behaviors to improve users sleep.

Got sleep?

Got sleep is an android application with the following features.

Initial Evaluation

Users are asked to fill out Pittsburg Sleep Quality Index questionnaire to evaluate their sleep habits at the beginning (Figure 1).



When have you usually gone to bed?

Choose Time

How long (in minutes) has it taken you to fall asleep each night?

0

Figure 1. Sleep habit evaluation using PSQI

Daily behavior & sleep environment monitoring

The app monitors users' behaviors and sleep environment and also collects subjective measures. These data are not only visualized on the graphs (Figure 2) but also used to personalize the feedback.

- Accelerometer

Accelerometer is used to monitor movement on the bed. We have been working on comparing phone accelerometer, actigraph and polysomnography data to develop algorithm to detect sleep/wake and sleep stages.

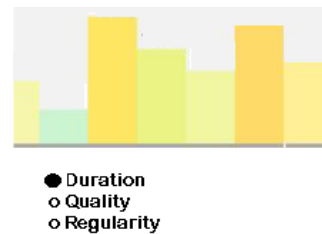


Figure 2. Visualization of sleep history.

- Light Exposure

Phone can be kept inside a pocket or in a bag; however, by exposing their phone to their bed-room, the app monitors ambient light intensity. Also, like f.lux, we can control the display brightness and color so that blue light does not disturb circadian rhythm and remove users' sleepiness at night.

- Sounds, humidity and temperature

Sound, humidity and temperature at the user's bedroom are monitored during their sleep.

- Phone usage

The app also monitors phone usage to understand how late users interact with their phone and what kinds of social interaction they have (phone call, sms, location and screen on timings).

- Daily questionnaire

Users are asked to fill out the timing and amount of food and caffeinated drink intake, exercise and subjective measures about sleep, health, mood and performance (Figure 3). These daily questionnaires can be customized in the settings depending on the users' behaviors.

Screenshot of the 'Daily questionnaire' interface. It shows two sliders for 'Sleep Quality' and 'General health when you woke up'. Each slider has a numerical input field (set to 0) and a range from 0 to 100. The 'Very Poor' and 'Excellent' labels are visible at the ends of the sliders.

Figure 3. Daily questionnaire

Feedback

Based on the sleep hygiene tips [8, 11], the app provides users feedback about the following factors.

- Sleep duration, quality and regularity
- Nap timing
- Exercise
- Sleep environment

- Caffeine/Alcohol/Meal timing/ amount
- Electronics usage

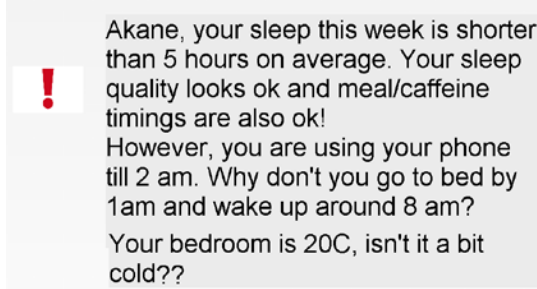


Figure 4. Example of feedback

To add playfulness

Sharing users' sleep scores to friends on social networks or Got Sleep? server or having a competition in groups could be good way for users to keep using the app for a long time and motivate each other.

Conclusions

In this paper, we propose Got sleep? an Android phone application which users can evaluate their sleep habits, monitor their daily sleep-related behaviors and feedback tips to them. We will evaluate long-term usability and effectiveness and investigate which functions will be more useful to help users to improve their sleep and engage users.

References

- [1] Bauer, J., Consolvo, S., Greenstein, B., et al. ShutEye. Proceedings of the 2012 ACM annual conference on Human Factors in Computing Systems - CHI '12, ACM Press (2012), 1401.
- [2] Van den Bulck, J. Text messaging as a cause of sleep interruption in adolescents, evidence from a

cross-sectional study. *Journal of Sleep Research* 12, 3 (2003), 263–263.

[3] Buxton, O.M., Cain, S.W., O'Connor, S.P., et al. Adverse metabolic consequences in humans of prolonged sleep restriction combined with circadian disruption. *Science translational medicine* 4, 129 (2012), 129ra43.

[4] Cohen, D.A., Wang, W., Wyatt, J.K., et al. Uncovering residual effects of chronic sleep loss on human performance. *Science translational medicine* 2, 14 (2010), 14ra3.

[5] Kay, M., Choe, E.K., Shepherd, J., et al. Lullaby. *Proceedings of the 2012 ACM Conference on Ubiquitous Computing - UbiComp '12*, ACM Press (2012), 226.

[6] Khalsa, S.B.S., Jewett, M.E., Cajochen, C., and Czeisler, C.A. A phase response curve to single bright light pulses in human subjects. *The Journal of physiology* 549, Pt 3 (2003), 945–52.

[7] Leproult, R. and Van Cauter, E. Role of sleep and sleep loss in hormonal release and metabolism. *Endocrine development* 17, (2010), 11–21.

[8] Sleep Hygiene Tips

http://www.cdc.gov/sleep/about_sleep/sleep_hygiene.htm

[9] Sleepio <http://www.sleepio.com>

[10] Thomée, S., Härenstam, A., and Hagberg, M. Mobile phone use and stress, sleep disturbances, and symptoms of depression among young adults--a prospective cohort study. *BMC public health* 11, (2011), 66.

[11] Twelve Simple Tips to Improve Your Sleep <http://healthysleep.med.harvard.edu/healthy/getting/overcoming/tips>

[12] Lamberti, Mary Patricia Khol, "Improving Sleep in College Students: An Educational Intervention" (2012). *Doctoral Dissertations*. Paper AAI3520443.