Opportunities for Computing Technologies to Support Healthy Sleep Behaviors

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Only **21%** of U.S. people sleep the recommended 8 hours



Number of Hours Slept per Night (Weekdays)

(2011 Sleep in America Poll)





Why Sleep?



Make sleep your foundation for good health.

Source: www.sleepfoundation.org

Sleep is associated with health risks



Our goal Explore opportunities for HCI in the domain of sleep

Study Procedure

Literature Review Contextual Inquiry Online Survey Interview Design Framework

Formative work – to identify design gaps

Literature Review

tracking sleep
waking and sleep aids
social applications









Actigraph



Fitbit



White Noise

Clocky

Zeo

BioBrite



social applications





Reverse Alarm Clock (Ozenc et al.)

BuddyClock (Kim et al.)

Network Alarm Clock (Schmidt et al.)



Opportunities for Innovation

There is limited discussion in existing literature about...

people's needs and current practices in regard to sleep

design implications of technologies used in a bedroom

the effectiveness & acceptability of in-home sleep sensing





Study Procedure

Literature Review Contextual Inquiry Online Survey Interviews Design Framework

Contextual Inquiry

Four sleep experts

Learned about

- Good sleep hygiene
- Treatments
- Existing sleep technologies

Online Survey

Interviews

- 230 people—female (57.8%) male (41.7%)
- 34 Questions with a mix of openended, multiple choice, and Likert type
- Helped define design requirements for technologies to support sleep
 - 16 people
 - Interested in sleep technology
 - Had experience with sleep disorders (insomnia, narcolepsy, parasomnia, sleep apnea, etc.)

Results Sleep hygiene Sleep disruptors Sleep aids/ waking methods Sleep-related health goals Attitudes toward technology

Sleep Hygiene

Recommendations for better sleep

SLEEP HYCIENE RECOMMENDATION

Keep a consistent wake time and amount each day, 7 days per week

2. Get up at the same time every morning.

If you do not fall asleep within 15 minutes of going to bed, get out of bed and engage in a quiet activity



Sleep disruptors



Response Count (multiple answers allowed)





Factors helping people sleep



Response Count (multiple answers allowed)





Strategies for waking

gradual vs. abrupt

[on success of dawn simulator]: "I think it was just something about **waking up more gradually** just felt more natural, like I've been rested as opposed to just like being jarred awake by a loud noise."

Others use **multiple alarm clocks** to ensure that they would get out of bed





User goals for sleep

Improving the consistency of sleep

- Becoming a morning person
- Breaking bad habits
- Becoming better educated on good sleep habits





Attitudes toward technologies

"A **non-intrusive** and low-cost system which can **automatically capture** sleep data and then display results over time."

"Minimal effort on my part.

I wouldn't do something that takes a significant amount of time or thought, especially in the morning."





Sleep Technology Design Framework



Goal

Feature

Source

Technology Platform

Stakeholder

Input Mechanism

Six Dimensions

Goal	Diagnosis	Treatment	Monitoring	Waking	Sleep inducing	
Feature	Awareness	Tracking	Persuasive	Education	Social	Entertainment
Source	Sleep medicine community	Peer-reviewed literature	Other literature	Popular media	Folk wisdom	None
Technology Platform	Wearable	Stand-alone	Mobile	Web	PC/laptop	Ubiquitous computing
Stakeholder	With sleep disorders	Without sleep disorders	Indirect stakeholders	Sleep clinicians	Sleep researchers	
Input Mechanism	Manual input by user	Automatic entry by sensors	None			

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Zeo Personal Sleep Coach







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Technology	Wearable	Stand-alone	Mobile	Web	PC/laptop	Ubiquitous
Platform						computing

Stakeholder	With sleep	Without sleep	Indirect	Sleep	Sleep
	disorders	disorders	stakeholders	clinicians	researchers

Input Mechanism	Manual input by user	Automatic entry by sensors	None
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Considerations & Opportunities

Tracking sleep trends over time is important

Long-term, automatic in-home sleep sensing solution There exists tensions between technology and sleep Technology: not a cure for every sleep problem Cultural differences can lead to different solutions HCI community can make a meaningful impact





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Questions: eunky@uw.edu

Appendix



Sleep Data

- Hours of sleep
- Time it took to fall asleep
- Numbers • Amount of time awake
 - Actual sleep time / Total time in bed
 - Number of awakenings
- **Subjective** Sleep quality

Guesstimate

How would you rate last night's sleep quality?

- 1) Very bad
- 2) Fairly bad
- 3) Fairly good
- 4) Very good





Persuasive strategies

Motivation

Goal Setting and Commitment

Rewards and Incentives

Self-monitoring

Increasing Information Awareness

Summary Feedback

Suggestion

Social Aspect





Actigraphy



Actigraphy







ZEO personal sleep coach



SleepCycle













BioBrite Sunrise Alarm







White Noise Generator

WHITE NOISE **Beach Waves are Crashing** Sound: Fan Beach Crickets τν Rain Air Chimes Clock Volume: 80 Timer: 4:00 0 Created by TMSOFT www.tmsoft.com



Reverse Alarm Clock

Ozenc, Jeong, Brommer, Shih, Au, Zimmerman DPPI 2007





BuddyClock

Kim, Kientz, Patel, Abowd CSCW 2008



