Ubiquitous and Mobile Computing CS 528:Introduce BeWell Health App
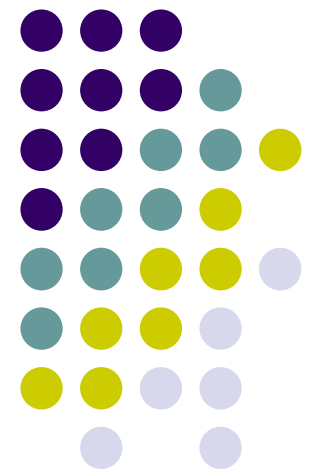
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BeWell: A Smartphone Application to Monitor, Model and Promote Wellbeing

Ⅰ .Introduction

- Reasons for developing BeWell APP
  - Concern about people's health
  - An absence of adequate tools for effective overall wellbeing and health
- Advantages of BeWell APP
  - Programming platforms, Application store
  - Monitor multiple dimensions of human behaviors
  - Automated inference human behaviors with sensors

I .Introduction

- Automatic aspects of BeWell
  - Monitor human's behaviors(activity, social, sleep)
  - Summarize the effect
  - Provide feedbacks

Fig. 1. BeWell approaches end-user self-management of wellbeing with three distinct phases. Initially, everyday behaviors are automatically monitored. Next, the impact of these lifestyle choices on overall personal health is quantified using a model of wellbeing. Finally, the computed wellbeing assessment drives feedback designed to promote and inform improved health levels.

Ⅱ. BeWell Architectural Design

- Monitor Behavior
  - Multiple dimensions, three parts
- Model Wellbeing
  - Multi-dimensional wellbeing scores (0-100)
- Promote and Inform End Users
  - Present richer information(directly, passively)

Ⅲ. Monitoring And Modeling Wellbeing

- Sleep
  - Focus solely on sleep duration
  - $sleep_{day}(\mathrm{HR}_{act}) = Ae^{-\frac{(\mathrm{HR}_{act}-\mathrm{HR}_{ideal})^2}{2(\mathrm{HR}_{hi}-\mathrm{HR}_{lo})^2}}$

- Physical Activity
  - Metabolic Equivalent of Task(MET) value
  - $physical_{day}(\mathrm{MET}_{act}) = (\mathrm{MET}_{hi} - \mathrm{MET}_{lo})\mathrm{MET}_{act} + \mathrm{MET}_{lo}$

- Social Interaction
  - Social isolation
  - $social_{day}(\mathrm{DUR}_{act}) = (\mathrm{DUR}_{hi} - \mathrm{DUR}_{lo})\mathrm{DUR}_{act} + \mathrm{DUR}_{lo}$

Ⅳ. Implementation

- ## Sensing Daemon
  - ### Two operating processes
  - ### Sleep model
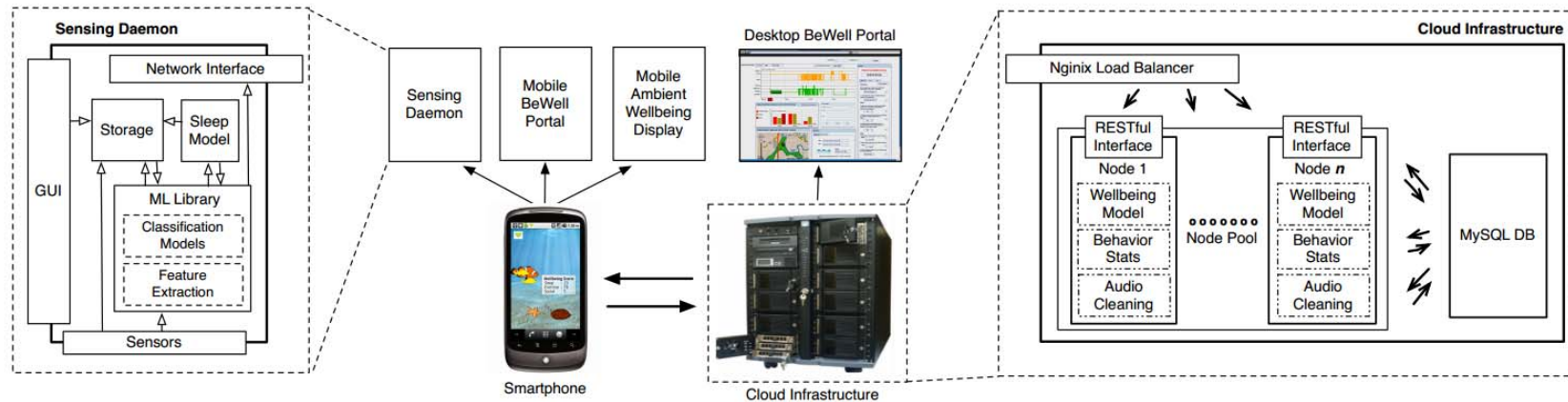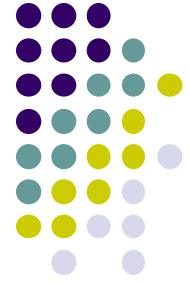 - ### Data storage

Fig. 2.   BeWell implementation, including smartphone components supported by a scalable cloud system

Ⅳ. Implementation

- Mobile BeWell Portal
- Cloud Infrastructure
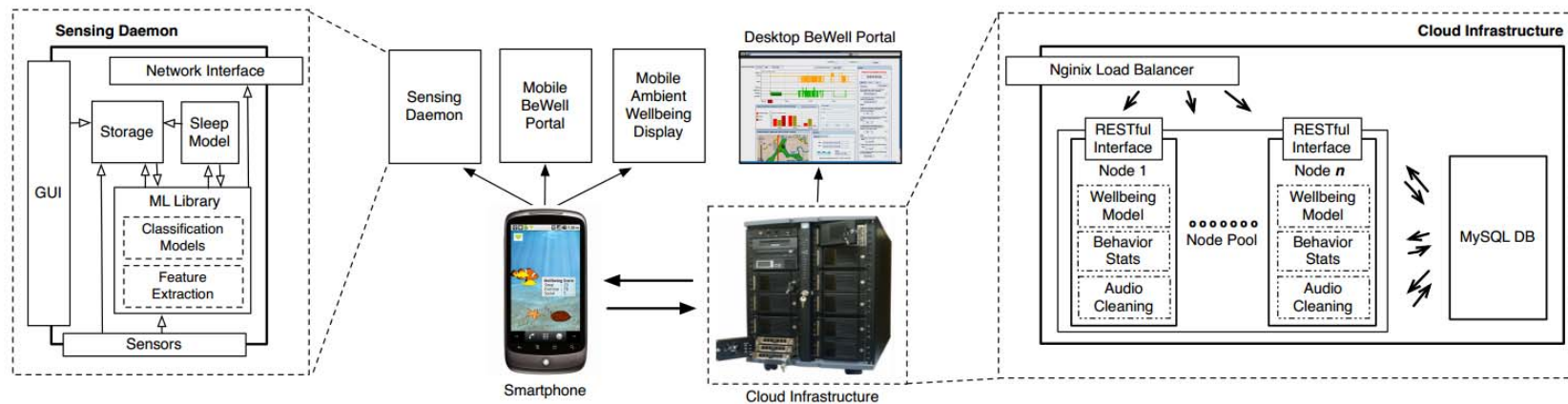 - Store SQLite files
  - Respond to queries for raw data

Fig. 2.   BeWell implementation, including smartphone components supported by a scalable cloud system

Ⅳ. Implementation

- Mobile Ambient Wellbeing Display
  - Display current user's state with animation
  - Turtle, Clown Fish, School of Fish

Fig. 4. Multiple wellbeing dimensions are displayed on the smartphone wallpaper. An animated aquatic ecosystem is shown with three different animals, the behavior of each is effected by changes in user wellbeing.

Ⅳ. Implementation
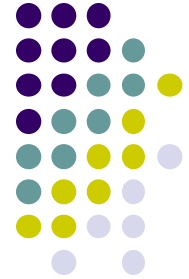
- ## Desktop BeWell Portal

  - ### Provide an automated behavioral patterns and wellbeing scores

  - ### Collect self-report survey

Link:
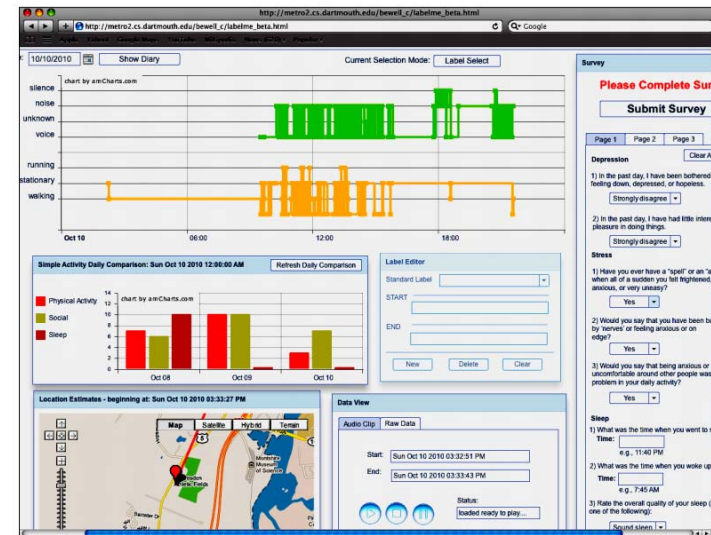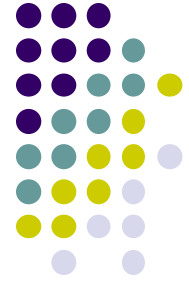http://metro2.cs.dartmouth.edu/bewell_c/labelme_beta.html

Fig. 3. The BeWell web portal provides access to an automated diary of activities and wellbeing scores.

Ⅴ. Evaluation

- ## Benchmarks

  - ### CPU, battery, memory and storage

BeWell Sensing Daemon		
	CPU Usage	Memory Usage
GUI only	0%	13511K
Audio sensor only	2%	14373K
Accel sensor only	2%	13917K
Audio classification	25%	14778K
Accel classification on	11%	14736K
Both Accel and Audio classification	31%	15357K
Benchmark Applications		
	CPU Usage	Memory Usage
MP3 Player	16%	27056K
Web Browser	5%	62376K

TABLE I
ANDROID NEXUS ONE CPU AND MEMORY USAGE FOR BEWELL AND
BENCHMARK APPLICATIONS
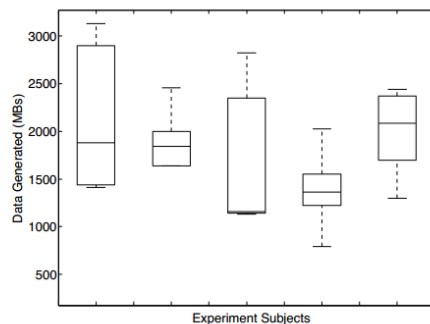
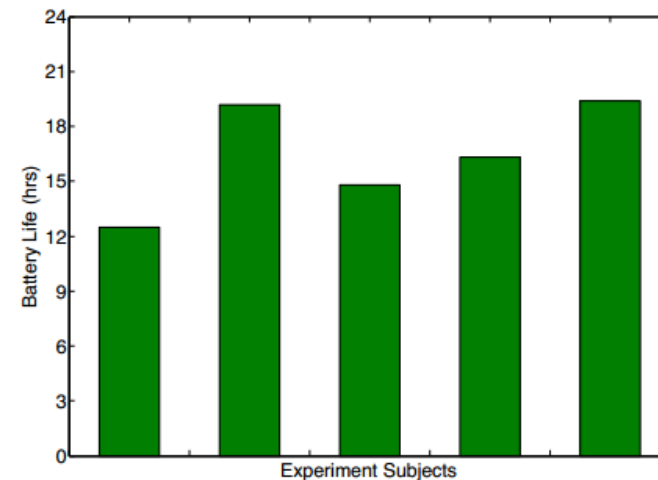Fig. 5.   Daily data generation by subjects during one week experiment

Fig. 6.   Smartphone battery life for subjects during experiment

Ⅴ. Evaluation

- Behavioral Inference Accuracy
  - Classification model is expected

	Voicing	Walking	Stationary	Running
Accuracy	85.3%	90.3%	94.3%	98.1%

TABLE II
BEHAVIOR CLASSIFICATION ACCURACY

  - Sleep model is expected

	RMSE	MAE
Linear Regression	2.18 hrs	1.54 hrs
Logistic regression	2.254 hrs	1.56 hrs

TABLE III
SLEEP DURATION ESTIMATE ERROR

  - Inaccuracies in monitoring user social interaction only with 14% accuracy

Ⅴ. Evaluation

- Wellbeing Experiment
  - Preliminary experiment is promising
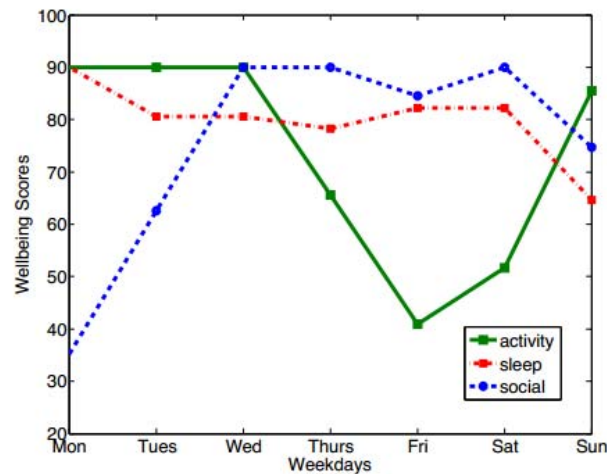
Fig. 7.   Automated wellbeing assessments for single representative user

VI. Related Work

- Apply a holistic approach to monitor wellbeing

- Automated sensor-based inferences

- BeWell focuses on sensing and monitoring humans just using embedded phone sensors

Ⅶ. Conclusion

- This app has been developed and can be downloaded online
  - Here is the link with video

  https://www.youtube.com/watch?v=Nah3sWGh21s

  - Here is the link with description on Application Store

  https://play.google.com/store/apps/details?id=org.bewellapp

VII. Conclusion

- Several pictures about the BeWell

VII. Conclusion

- Extension work
  - Conduct a large-scale deployment
  - Conduct user study to better understand different users
- What I learn
  - How sensors can be used to make health app
  - How to write an academic paper for developing an app
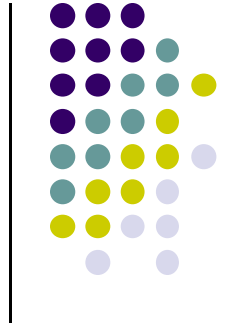
VII. Conclusion

- Comments
  - Clear paper structure
  - Detailed description in each section
  - Proposal interesting questions and solve them
  - Convincing experimental results

References

- *Bewell: A Smartphone Application to Monitor, Model and Promote Wellbeing*

- *The Influence of Physical Activity on Mental Well-being*

- *App store:* https://play.google.com/store/apps/details?id=org.bewellapp

- *App video:* https://www.youtube.com/watch?v=Nah3sWGh21s

Q&A

Thank you!!