Sundroid: Solar Radiation Awareness with Smartphones

CSCI780 Sensors and Ubiquitous Computing

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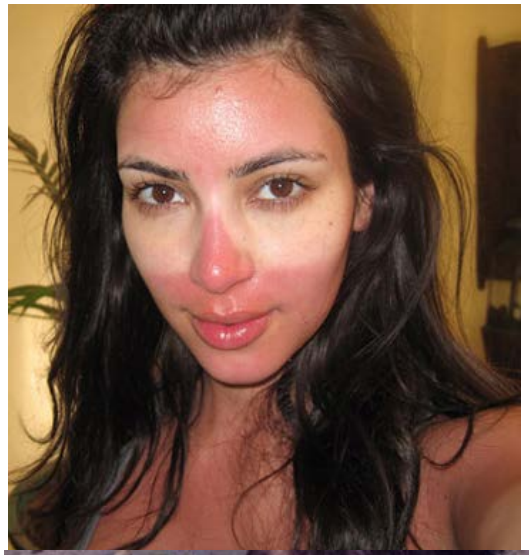
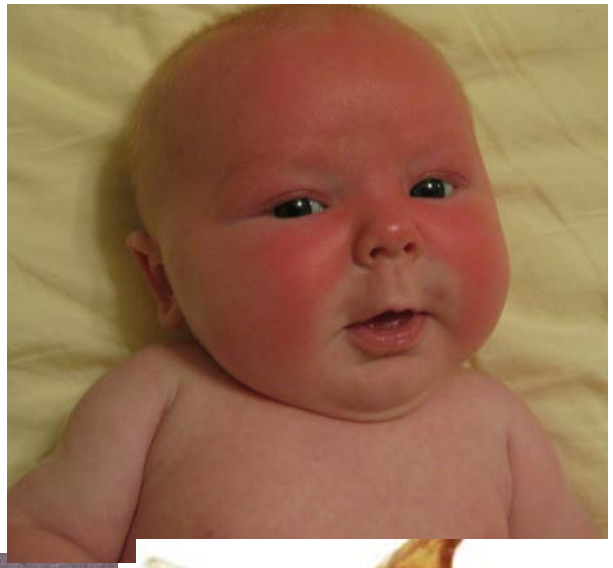
Life is good -- enjoy sunlight!

Life can be tough – Don’t get burned!





What can we do to let them
enjoy the sunlight
while
not get burned or toasted?

Outline

- Introduction
- Survey
- System Design
- Evaluation
- Pilot Study
- Conclusion
- Discussions

Survey

- Settings
  - Online survey
  - 785 students (52% male, 48% female)
- Questions
  - Do people have the knowledge of sunburn and its risks?
  - How often people get burned & why this happens?
  - Whether people believe that a warning system could prevent some of the sunburns they suffer?
  - Will people be willing to use a sunburn warning system & what type of system people want to use?

Survey (continue)

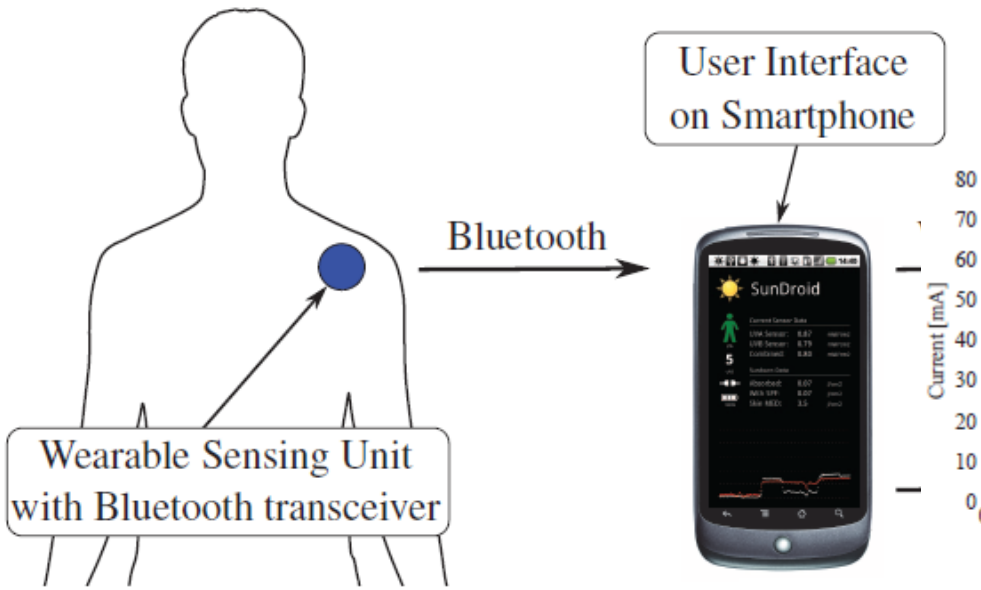
	Category of answer	Percentage
1.	Misjudgment the solar radiation	23%
2.	No sunscreen at hand	19%
3.	Staying in the sun for too long	18%
4.	Incorrect/insufficient application of sunscreen	13%
5.	Forgot to apply sunscreen	13%
6.	Did not pay attention	10%
7.	Sport activities	10%
8.	The skin was not yet accustomed to the sun (mostly in spring)	8%
9.	Did not apply sunscreen (reason unknown)	8%
10.	Sleeping in the sun	6%

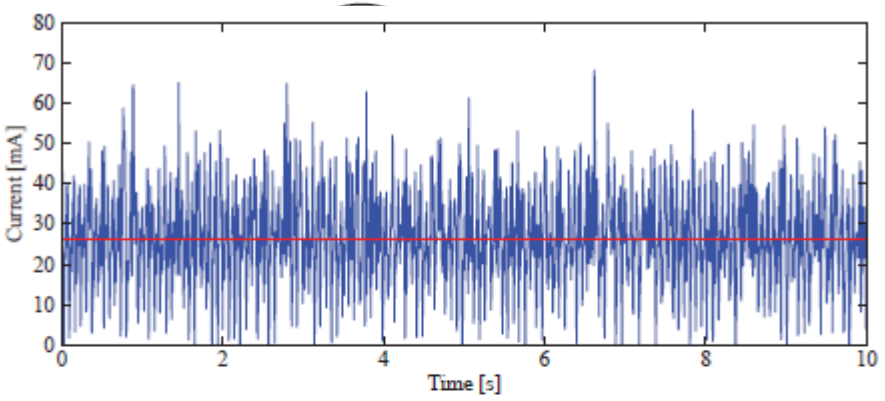
Table 1. Most popular reasons for sunburn according to our survey. A single answer could have been assigned to more than one category. Therefore percentage numbers do not sum up to 100%.

Survey (continue)

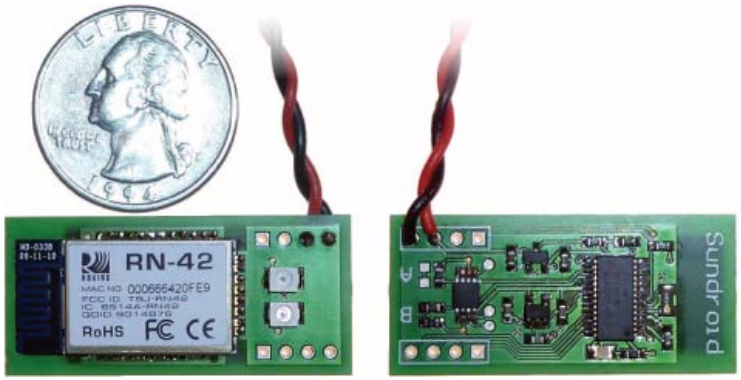
- Results
  - A significant fraction of the people (67%) suffer a sunburn regularly (at least once a year), despite their knowledge of the risks and countermeasures.
  - A lot of the reasons for getting sunburned are related to inattention and misjudgment of the sun's intensity, and could be overcome by an adequate warning mechanism.
  - Many people are willing to use such a warning system in form of a smartphone application and/or dedicated sensor device.

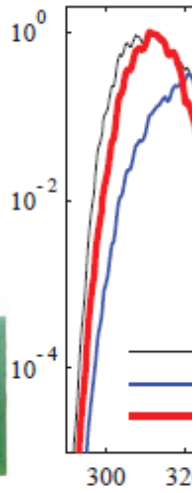
Sundroid Design

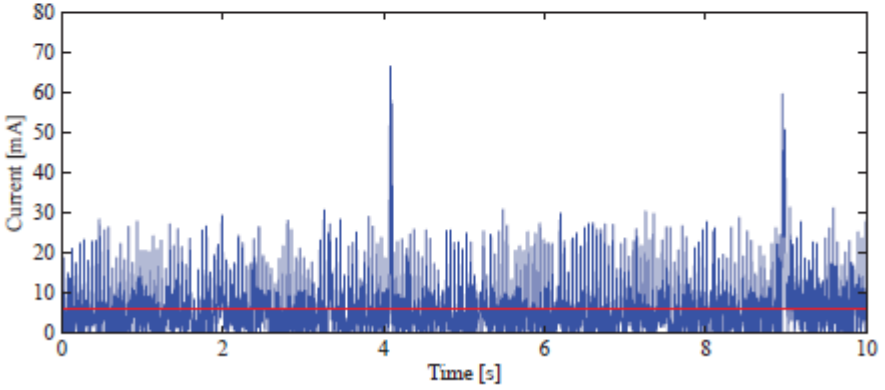




(a) Bluetooth module in standard mode



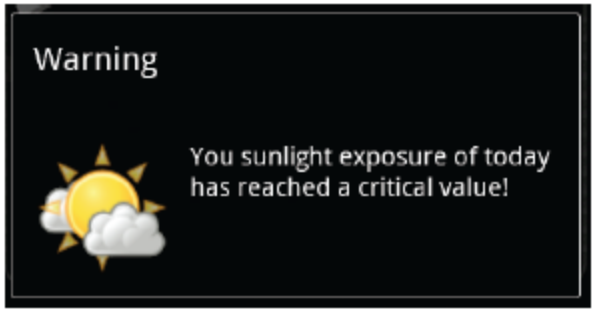


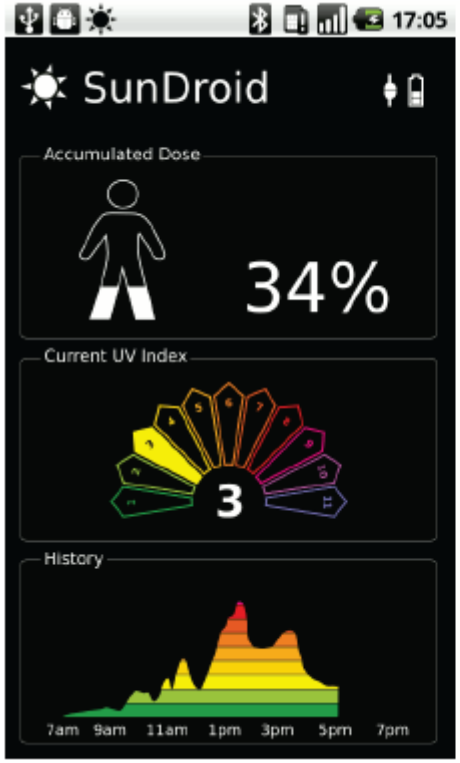


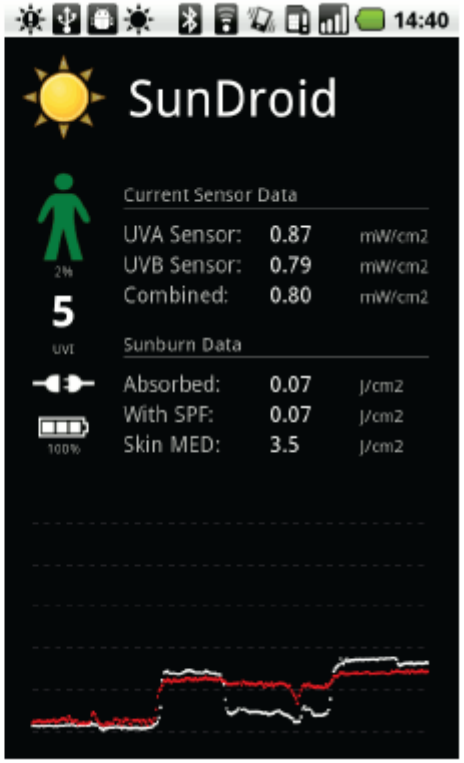
(b) Bluetooth module in low-power mode

Smartphone Application

- Data Processing & Visualization
  - Simple view
  - Advanced
- Data Fusion



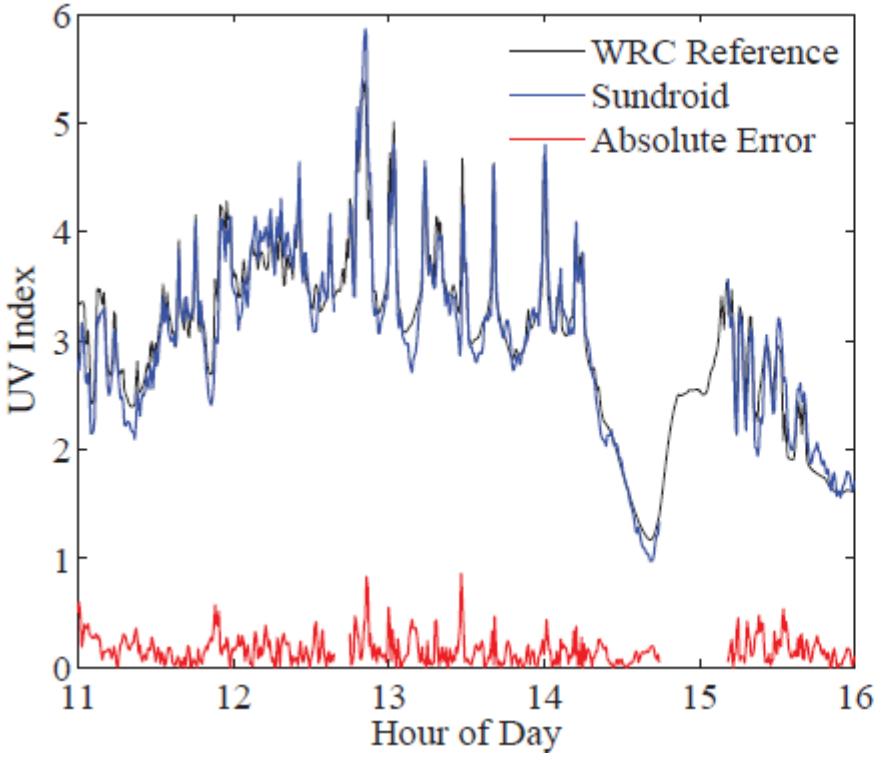




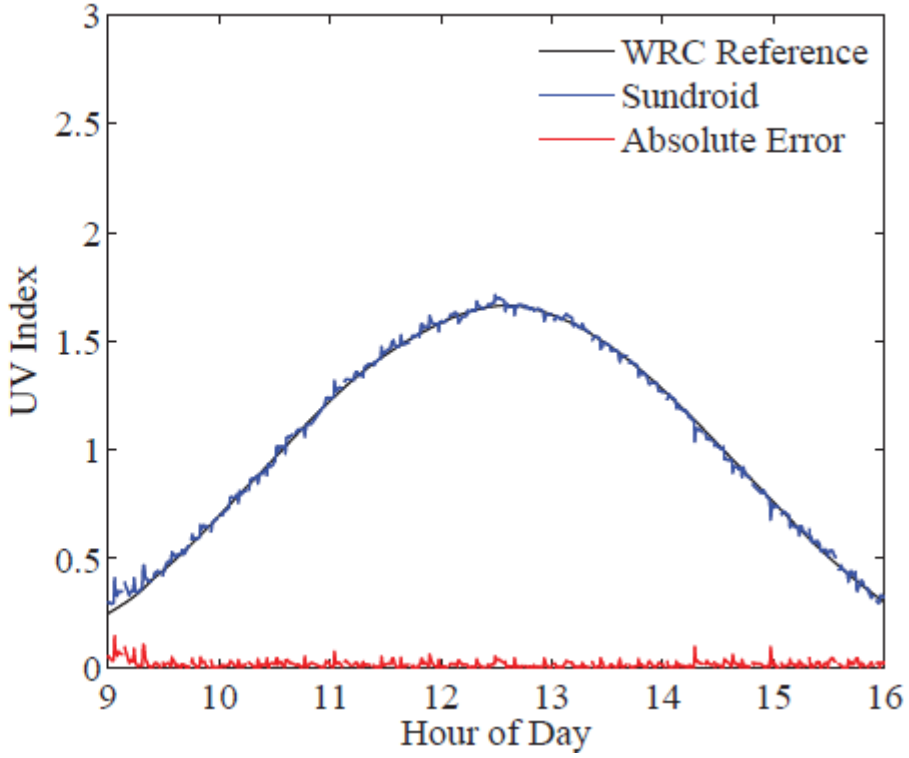
Skin type	Description	MED in $\frac{mJ}{cm^2}$
1	White, very fair skin	20 - 35
2	White, fair skin	30 - 45
3	Beige skin	40 - 55
4	Beige to brown skin	50 - 80
5	Dark brown skin	70 - 100
6	Black skin	100

More functions?
Better HCI like notifications?

Evaluation -- Accuracy

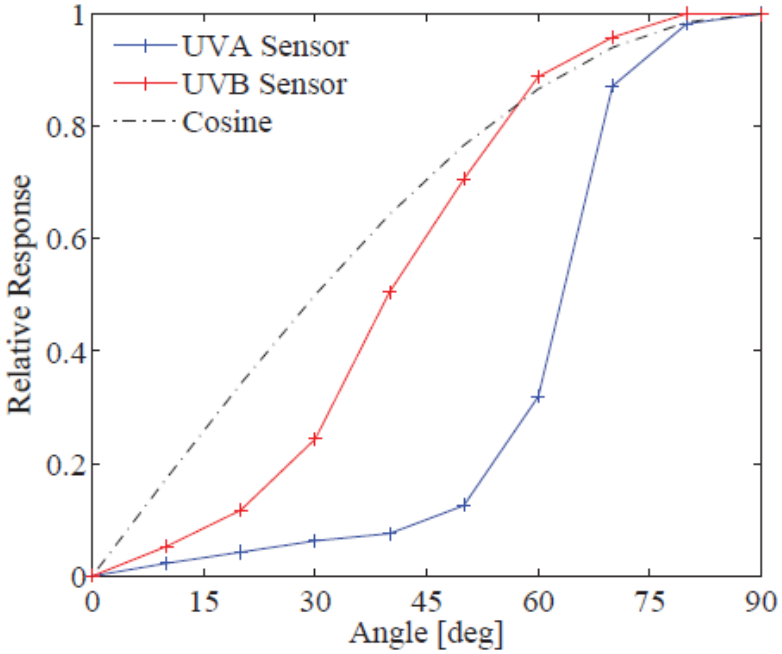


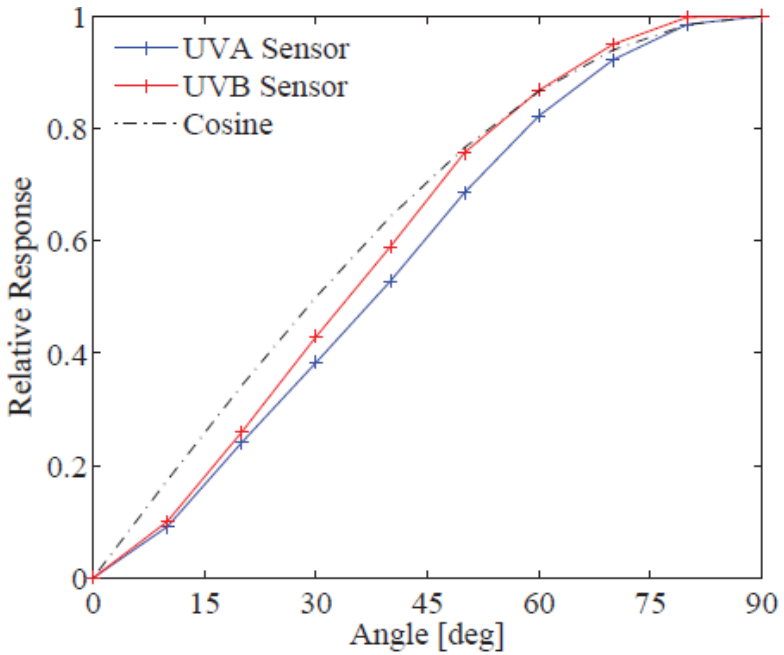
Autumn: partly cloudy



Winter: sunny

Evaluation -- Sensitivity





Ideally, the response should follow a sine curve

Placing a PTFE diffuser foil on top of sensors enabled it

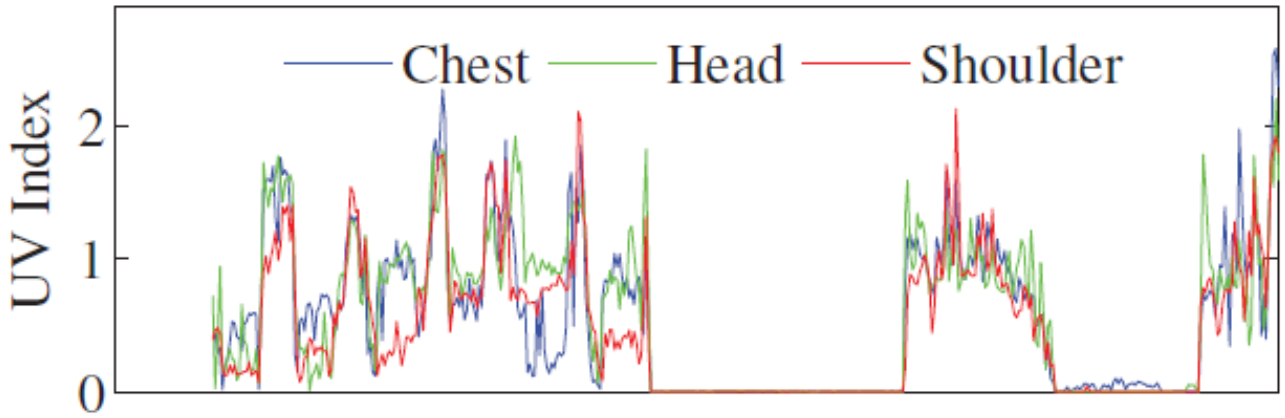
A software solution may also exist?
But may no longer needed!

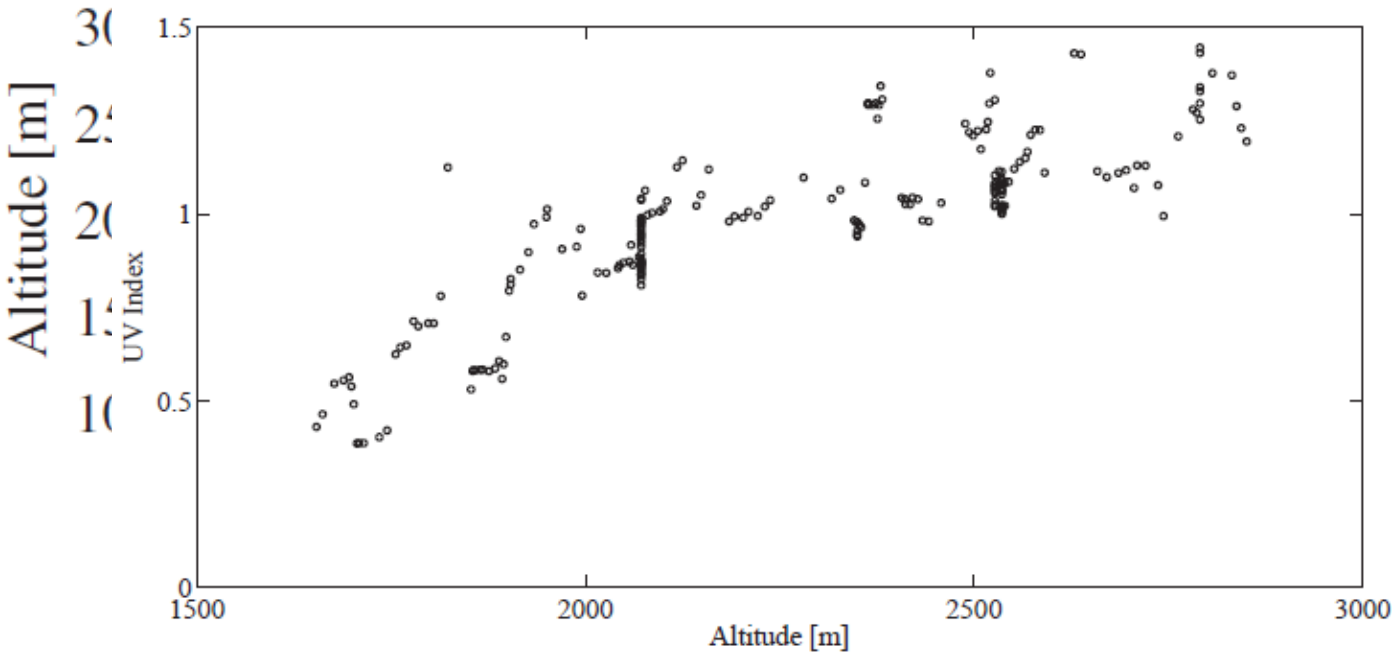
What else to add for evaluation?

- What has been done?
  - Compared with WRC reference for accuracy
  - Sensitivity to the direction of radiation
  - ?
- What else can be added?
  - What is the cost?
  - Energy overhead?
  - CPU/Memory/xxx impact on smartphone?
  - How long will the sensor last?
  - ???

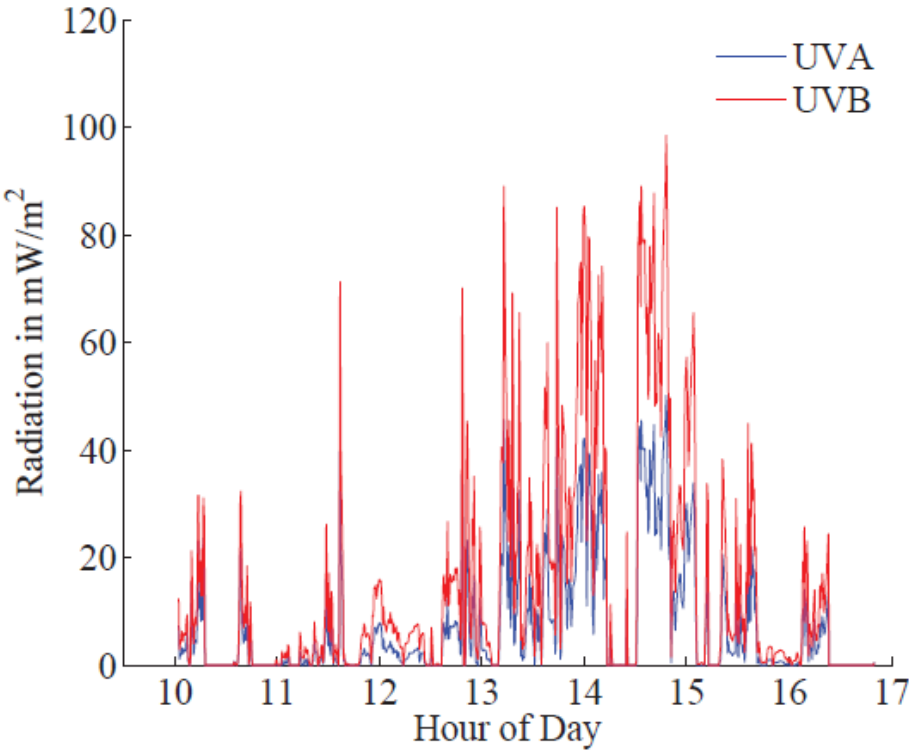
Pilot Study -- Snowboarding

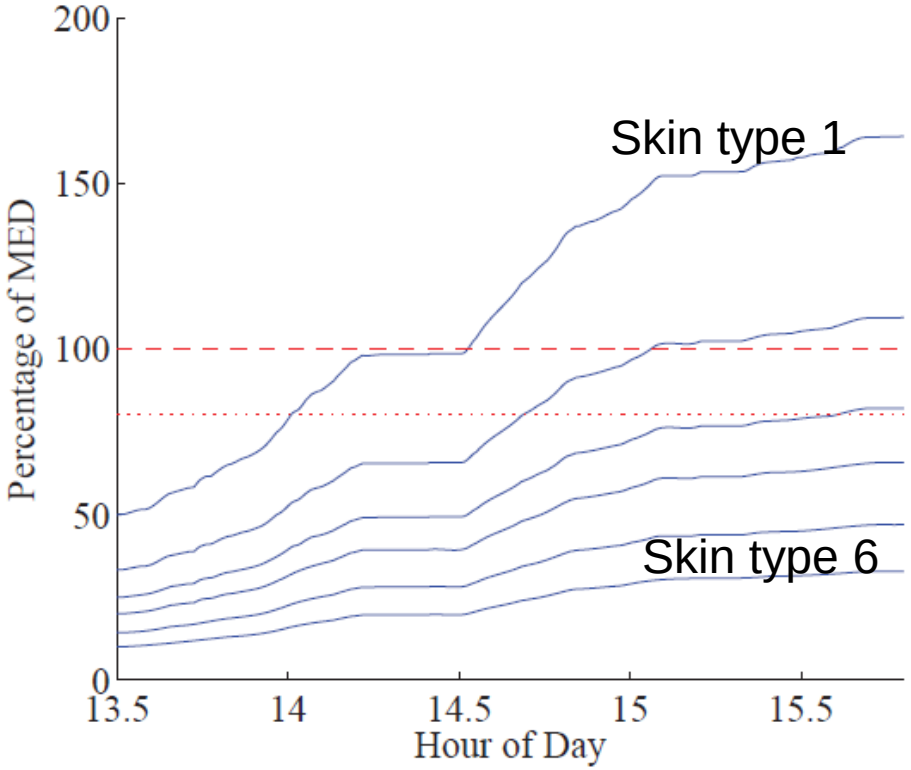
- Two zero-reading periods
- Chest sensor gets 10% more energy than head sensor
- Where to put the sensors?
- UV index vs. altitude





Pilot Study -- Climbing





- Climbing on a sunny spring day
- People with different skin types can be warned at different times

Extending the pilot studies?

- What do users get for right now?
  - Popup window notification when absorbed UV radiation exceeds a critical level
  - Check your radiation absorption status
- What can be added?
  - An app for snowboarding?
    - Other sensors available in smartphone
    - Optimal snowboarding route panning? ……
  - An app for climbing?
    - Other sensors available in smartphone
  - Any other app to use UV sensors?

Conclusion

- This paper propose, implement, and evaluate Sundroid, a wearable hardware/software system that tracks the wearer's sunlight exposure in real-time.

Discussions

- Survey before system design
  - vs. survey after system design
  - Pros and cons?
- Schematic overview
  - Vs. system architecture for starting the design section (in SurroundSense)
  - Vs. system architecture in implementation section (in Borealis)
  - Pros and cons?
- Real experiments (snowboarding/climbing) in pilot study
  - Vs. real experiment in evaluation section in other papers, e.g. shop classification in SurroundSense
  - Pros and cons?