Specific Targeted Research Project

Ambient Lighting Assistance for an Ageing Population

ALADIN Consortium
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Main project resources

Start: January 2007
End: December 2008
Partner: 7 contractors
Human: 280 person months
Total costs: 2.600.000 Euro
EC grant: 1.800.000 Euro

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Project objectives

„ALADIN aims at developing an intelligent assistive system based on ambient lighting to support mental alertness and memory performance as well as relaxation in specific situations. The system is also expected to assist with regulating circadian rhythms.“

ALADIN applications:
■ Automatic lighting
■ Manual lighting
■ Exercises
■ History
■ Advice & support

Innovative aspects

How do we go beyond the state-of-the art?

■ by developing an intelligent control system that is capable of capturing and analysing the individual and situational differences of the psycho-physiological effects of lighting
■ by enabling the users to make adaptations tailored to their specific needs and wishes
Major achievements

- In-depth empirical data about user needs, expectations and requirements
- Extensive review of the recent scientific literature on the impact of light on health and wellbeing
- Psycho-physiological target values for activation and relaxation based on lab tests
- Psycho-physiological effects of different light parameters on activation and relaxation measured in lab tests
- Development of ALADIN prototype which includes
  - lighting and room control systems,
  - sensor devices for capturing psycho-physiological signals as well as
  - software applications and
  - algorithms for adaptation of lighting
- Preparation of field tests (definition of selection criteria, selection of evaluation instruments, expert reviews and end-user testing)

Psycho-physiological effects of lighting

Age of test subjects: 65 – 82 years

- show best CPT performance with 6500 K / 500 cd/m²
- feel most activated with 4000 K / 500 cd/m²
- feel most relaxed with 50 cd/m² independent of light colour

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Description of lighting installation

Results from psycho-physiological tests

Studying different activities under the same lighting

1. Lying down relaxed with eyes closed.
2. Lying down relaxed with eyes open.
3. Sitting relaxed with eyes open.
4. Sitting and watching a „calm“ nature video.
5. Sitting and watching an „exciting“ nature video.
6. Standing up from sitting and stay standing.
7. Performing VDT task as quickly and as accurately as possible.

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Different steps of biosensor development

**Advantages**
- wireless
- non-intrusive
- easy to use

**Disadvantages**
- big case
- heavy weight
- use of liquids and/or adhesives
- lots of cables
- difficult to attach
- use of liquids and/or adhesives
- may restrict movement of hand

Interactive TV – User interface

Aladin applications:
- Automatic lighting
- Manual lighting
- Exercises
- History
- Advice & support
Automatic adaptive lighting

User is in control and can choose from a selection of predefined light situations. The following questions had to be answered:

- Selection of predefined light situations versus continuous light adjustment by users?

- Scrolling through a menu with one option per screen versus including all options in one hierarchical menu?

- Offering key buttons on remote control versus using cursor buttons?
Relaxation exercises - biofeedback

- Electrodermal activity
- Heart beats per minute

Mean of 10 seniors

Activation exercises

Mean, maxima, and minima of correct and incorrect answers

10 elderly

Correct Incorrect

Calculating Guessing Reading Memorizing

Übungen

Richtig oder Falsch?

0+0+6+8 = 15

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History – User self-evaluation

**Neural Network Classification**

- Exercises
- Single value per daytime
- Training data from experts

**k-Nearest Neighbor Classification**

- Values from exercises
- Visualisation of history

**Exercises**

1. Is not able to activate in the morning if necessary.
2. Is not able to relax in the morning if necessary.
3. Is not able to activate in the afternoon if necessary.
4. Is not able to relax in the afternoon if necessary.
5. Is not able to activate in the evening if necessary.
6. Is not able to relax in the evening if necessary.
7. Did not make enough exercises in the morning.
8. Did not make enough exercises in the afternoon.
9. Did not make enough exercises in the evening.
10. Recorded data are difficult to understand.
11. Is able to activate and relax if necessary.

**Advice and support application**

- kNN analysis of the exercise data of the past five days.
- Pool of ca. 50 recommendations
- User is presented with 1-3 recommendations.
Main findings - Summary

- The elderly are an extremely heterogeneous group ranging from the active, and healthy to the fragile and home-bound.
- The different lighting situations (dim and bright) have a clear impact on older adults in terms of activation and relaxation.
- Skin conductance response (SCR) has proved to be the most appropriate psycho-physiological target value for automatic lighting adaptation; heart rate is the second candidate.
- Conventional sensor devices have many limitations

Outlook

- Extend the system to other application domains e.g. care facilities, hospitals, offices
- Extend the system to other target groups, e.g. people who suffer from seasonal depression, sleeping problems etc.
- Use lighting for other purposes apart from enhancing wellbeing, e.g. for navigational or orientation purposes
- Incorporate the adaptive lighting system into a general assistive environment
- Extend the system to include other environmental factors such as temperature, acoustics, colour or information displays.