Ambient Lighting Assistance for an Ageing Population

Deliverable 4.1:

Report on test results and the evaluation of the system as a whole

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This document forms part of the Specific Targeted Research Project (STREP) “Ambient Lighting Assistance for an Ageing Population” (ALADIN) funded by the Information Society Technologies (IST) priority of the Sixth Framework Programme of the European Commission as project number IST-045148. The ALADIN project aims at the following Deliverables:

D1.1 Specification of the criteria for selecting the test persons, i.e. the sample of users to be involved (incl. a justification for the selection of the sample) and the description of tests to be performed.
D1.2 Description of every-day events and activities where daylight and artificial light play a major role including the corresponding psycho-physiological effects on individuals.
D1.3 Description of support and advice measures aimed at preserving the mental and physical fitness of older adults.
D1.4 Project presentation.
D1.5 Final plan for using and disseminating knowledge.
D2.1 Measuring instruments that capture the psycho-physiological data in every-day events and activities of older adults in place.
D2.2 Modular components that can be combined for achieving cost-effective lighting systems and allow continuous and hardly noticeable changes of certain lighting parameters.
D3.1 The intelligent and adaptive lighting control system is ready for testing.
D3.2 GUI with manual user controls for light parameters is ready for testing.
D3.3 A classical biofeedback solution is ready for testing.
D3.4 An advice and support application for enhancing the mental and physical fitness of older adults is ready for testing.
D3.5 Application for visualising one’s psycho-physiological data including information about how these are correlated with one’s emotional and physical state is ready for testing.
D4.1 Report on the test results and the evaluation of the system as a whole.
D4.2 Fully functional solution (soft- and hardware) including possible redesigns and extensions.
D4.3 Description of a general model about the correlations between environmental variables and the psycho-physiological states of older adults.
D5.1 List of publications, press releases, scientific papers and guidance notes for designers.
D6.1 Consortium agreement, progress reports, final report including the evaluation results.

The ALADIN project and its objectives are documented at the project website www.ambient-lighting.eu. More information on ALADIN and its results can also be obtained from:

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Table of Contents

1 Introduction 3
2 Objectives and methodology 3
2.1 Functions to be tested 3
2.2 Survey instruments and variables 3
2.3 Test design 3
3 Field work 3
3.1 Recruitment of test persons 3
3.2 Logistics and installation 3
3.3 Data collection 3
3.4 Focus groups 3
3.5 Usability and accessibility optimization 3
3.6 Lab experiments with ALADIN prototype 3
4 Results 3
4.1 Functioning of the prototype 3
4.2 Effects on test persons’ wellbeing 3
4.2.1 Improvement of well-being and quality of life 3
4.2.2 Sleep quality 3
4.2.3 Impact on mental fitness 3
4.3 User acceptance and customer satisfaction 3
4.3.1 Technical affinity 3
4.3.2 Attitude towards technology 3
4.3.3 Acceptance of the ALADIN prototype 3
4.3.4 Usability of the ALADIN prototype 3
4.3.5 Customer satisfaction 3
5 Conclusions 3
5.1 Possible improvements concerning the prototype 3
5.2 Possible improvements concerning the field tests 3
5.3 Need for further research 3
Annex A. Brief case stories 3
Annex B. Field Test Manual 3
1 Introduction

The present deliverable aims at giving a descriptive overview of the fieldwork done in Workpackage 4 by the respective partners and to evaluate the ALADIN prototype as a whole with regard to its underlying purpose which is to enhance the overall mental and physical well-being of older adults. Furthermore, this deliverable gives an overview on iterative user tests and expert reviews conducted to optimise usability and accessibility of the ALADIN prototype.

The fully developed ALADIN prototype consists of an Apple Mini Mac with the installed software booting up automatically, a flat screen television set with service and control interfaces, a USB driven IR system connected to a normal remote control, a sensor glove with integrated variopoint device and bluetooth connection, and a Luxmate bus box controlling illumination panels on all four walls of the selected room and a ceiling lamp above the table where the test person spends most of the time. The lighting devices consist of luminaires of two colours which can be mixed by changing their intensity.

![Fig. 1: ALADIN components for field test (lighting, mini computer, television, sensor glove, remote control).](image)

The computer and the flat screen (available in different sizes) are meant to replace the existing TV set and be integrated into the home entertainment system. For the field trials, the lighting component is installed temporarily and can be adapted individually to the characteristics of the room (size of room, height of walls, colour of ceiling). So each testing prototype is an individual and flexible composition of the ALADIN components. In the field tests, the prototype was installed for about 9 to 12 weeks in the household of older adults and subsequently removed without leaving any traces.

The 12 field tests were grouped together in a within-subject design with three phases each intending to test the system without light and with two different algorithms of automatic light adaptation. The tests were conducted partly serially one after another and partly overlapping to cover the whole test period with only four complete light components. Six field tests were carried out by LMU-MUENCHEN (Germany), two by FHV and BLL (both in Austria), and two by APOLLIS (Italy).

2 Objectives and methodology
The objective of the field tests was to test the ALADIN prototype under real life conditions in private households of elderly singles who correspond as much as possible to the target group discussed in D1.1 (Becker & Vanzo 2007). that is: elderly singles with starting age-related constrains but mentally fit enough and willing to handle a technical device in everyday life. The basic questions were:

- Do the prototype and all its components work as intended?
- Which are the objective effects of the whole system on the test persons' well-being and mental fitness?
- How are the subjective experiences of the test persons with the system in terms of acceptance, usability and customer satisfaction?

The functionality and operability of the ALADIN prototype comprise the technically correct integration and working together of all components. The aim was to test the prototype under real life conditions and in situations that cannot be simulated in the laboratory by giving it into the hands of normal elderly users. The different functions were examined by the technical experts. An important data source were constituted by the log files which recorded the important input and output events with their current parameters.

Regarding the objective effects of the ALADIN prototype the goal was to prove the hypothesis that the ALADIN system as a whole and especially the adaptive lighting leads to a significant improvement in terms of well-being and mental and physical fitness. Data regarding well-being and fitness were partly recorded on log files by the system itself through the biosignal sensors and exercise results. Another important data source was provided by repeated interviews in which well-established questionnaire instruments were used (see chapter 3.3).

Concerning the subjective experience of the test persons we did not assume an underlying hypothesis (e.g. to which degree the prototype would be accepted or rated as useful), but the goal was to measure acceptance, subjective usability and satisfaction as an intermediate variable, which can enhance (or distort) the objective effects of ALADIN on well-being and fitness. The aim was also to collect useful information from the perspective of the target group in order to improve the prototype for later commercialisation. Related data was recorded by quantitative und qualitative surveying (see chapter 3.3).

2.1 Functions to be tested

As said in the beginning the ALADIN prototype consists of a computer TV combination which replaces the existing TV set. This combination works independently from the light component and offers the following functions, always departing from the automatically loaded main menu:

2.1.1 Watching TV

As a standard TV set the ALADIN prototype offers the possibility to watch TV. The flat screen device is able to process analogue or digital terrestrial signals and disposes of AV (audio/video) entries to connect satellite receivers or any type of video recorder.

2.1.2 Exercises/ biofeedback

There are two types of exercises available:

- Two relaxation exercises (biofeedback), muscle tension and breath control, require the use of the sensor glove. Accompanied by recreative music the test persons can try to relax themselves for about a few minutes and meanwhile observe the result of their effort as the actual heart rate or skin conductance is displayed on the screen together with the general tendency shown by an avatar with changing mimics.
- Four activation exercises, mental arithmetic, letter rows, coloured stones, and term memory, can be played without the sensor glove and are supposed to stimulate the level of concentration by claiming during some minutes quick, continuous, and correct decisions to be transmitted via the remote control.
Both types of exercises end after a time bar on the screen is used up and finish with a short evaluation of the test person's performance.

2.1.3 History
With the history function the test persons are able to look back at the exercises of the past week. Frequency and success of the exercises are displayed. If the exercises are carried out with sufficient frequency the ALADIN prototype gives also a general comment about the performance in the exercises.

2.1.4 Advice and Support
If the exercises are carried out adequately, that is three times a day for three consecutive days, ALADIN gives not only a general comment about the performance in the exercises, but depending on it gives advice for a better well-being. The range of hints and tips can be individually adapted to the test person's needs and refer to various activities like going outdoors, doing sports, meeting other people etc.

2.1.5 Automatic light adaptation
The light component is installed separately and upgrades the functionality of the computer TV setup by adding the possibility to adapt the illumination of the room manually via remote control or automatically via biosignals.

Automatic lighting adapts the illumination to achieve an activating or relaxing effect. The only thing the user has got to decide is whether the adaptive light should be more activating or more relaxing. This function requires the use of the sensor glove and can be used as long as preferred and stopped at any moment. Because of the great diversity of situations, events or individuals, the direction of change or adaptation is unlikely to be known beforehand. We have opted for genetic and simulated annealing algorithms to implement adaptive control.

2.1.6 Manual light control
After a preliminary configuration together with the assistant the test person can chose from a list of presets to adapt the light conditions to her/his preferences, e.g. for watching TV, to enhance daylight or to do visually demanding tasks. Some of these presets can even be chosen by making use of a conventional switchbox without the use of the ALADIN menu.

2.1.7 Assistant
The assistant was not a function of the ALADIN prototype, but a necessary element of the field test. Each test person was assigned a particular assistant who visited or called at least once a week. They were present more frequently in the beginning because the prototype was not self-explanatory enough to let the test persons explore it on their own. The assistants collected the data which is presented in this report on the field tests and also helped to install, adapt and introduce the various applications of ALADIN. As the assistants were available almost on demand” to coach the test persons or to solve whatsoever problem, they have to be considered an important „disturbance variable”.
2.2 Survey instruments and variables

Data collection was done both with qualitative and quantitutive methods and was mostly organised along five sample points which were determined by the test design (see chapter below). The following mostly well-established instruments were used in the course of the field tests:

- **WHO-5-Well-being**: In order to measure general well-being a short questionnaire was used which had proven to be valid for a large range of different target groups including elderly people (Bonsignore et al. 2001).

- As a further and more complex instrument to examine well-being and **life quality** the „Skalen zur Erfassung der Lebensqualität SEL” (Life Quality Inventory) was used (Averbeck et al. 1997). It combines physical, mental, and social dimensions of well-being and life satisfaction to an overall indicator of life quality.

- As it is frequently observed that sleep quality decays with age, the **Pittsburgh Sleep Quality Index PSQI**, a short questionnaire referring to various factors of good sleep, was integrated into the repeated surveying.

- As an objective indicator also **mental fitness** tests were carried out. From the **Nuremberg Age Inventory** (Oswald & Fleischmann 1997) the number connection test (seconds) and the image recall test (number of images recalled) were chosen to be integrated into the regular pencil-and-paper-interviews. Data on mental fitness can also be derived from the **log data** using the test persons' performance in the exercises as an indicator for mental fitness (having of course in mind that they were not carried out under controlled circumstances).
The examination of **physical fitness** without a medical visit proved to be more difficult. The system itself offered a functionality for the assistant to measure the physical fitness of the test person by some specific exercises but they were carried out too rarely to be of use as data for the field test evaluation.

Acceptance and **Customer Satisfaction** were surveyed by a questionnaire designed by APOLLIS. It was based on three dimensions: Technical **affinity**, that is the predisposition to use technology in everyday life was measured by the use of technical devices which had proven to form a valid instrument after the preliminary empirical study carried out in South Tyrol. **Attitudes** towards technology were surveyed by a newly designed ten-items scale. The frequency of specific experiences and feelings regarding the use of ALADIN were surveyed in order to get the subjective view of the test person about the effects on themselves as a first indicator of **customer satisfaction**. A more direct way to measure satisfaction consisted in ratings which the test persons gave concerning the different components of the ALADIN prototype. The underlying reasons of the ratings were collected as qualitative data.

**Usability** is quite close to customer satisfaction and was measured by two well-established instruments: The **AttrakDiff** questionnaire combines pragmatic and hedonic quality aspects to a pluridimensional customer satisfaction concept in which the emotional „joy of use” plays an important role (Hassenzahl et al. 2003). The **ISO-Norm 9241** is on the other hand a rather functional tool to survey the usability of software. It is based on certain guidelines which such products should follow (Gediga et al. 1999).

As already mentioned the ALADIN prototype recorded almost every event on **log data** files. These give additional information not only about the operability of the system but also about the **user behaviour** that is e.g. date, time, frequency and duration of usage of the different ALADIN functions. From this data we can derive objective conclusions about acceptance, usage patterns, and favourite functions and therewith control the more subjective interview results.

In order to collect additional qualitative data the test person were asked to keep a **diary** in which all the assistant's visits, malfunctions or particular events which might have an impact were recorded.

In the course of the field tests it became clear that given the small number of test persons additional qualitative data could be very valuable. So two **focus groups** were carried out after the experiments to gather the long term subjective impressions of the test persons. Instead of individual in-depth interviews the focus group aimed at eliciting further arguments on the subject by free exchange of experiences and group discussion.

The quantitative survey data was put together in an SPSS data file comprising 60 data rows, that is five rows for each of the 12 test persons. Log data was summarised and aggregated to this data format and also integrated. Qualitative data was analysed separately.

### 2.3 Test design

The field tests were mainly divided by three periods with five sample points before, after, and in between the different periods.

The **baseline test** was done before the installation of any ALADIN component and comprised the inclusion criteria of the recruitment phase, the socio-demographic variables and personal data, the measurement of the room, information about everyday activities and room use, and the whole lineup of the specific survey instruments (with exception of those which referred to the ALADIN prototype of course). According to the within-subject design the baseline test played the role of a „control group”.

The quantitative survey data was put together in an SPSS data file comprising 60 data rows, that is five rows for each of the 12 test persons. Log data was summarised and aggregated to this data format and also integrated. Qualitative data was analysed separately.
After the installation of the TV computer combination the test persons started using the ALADIN prototype functions except for light. A possible increase of well-being could be correlated to the positive effect of the exercises and the advice given. This phase of advice and support (AS) ended after three weeks with detailed testing using the specific survey instruments. Then the lighting component was installed.

The AS phase was followed by two rotating test phases with the lighting component installed. The phases differed by the algorithm which automatically adapts the light parameters to the measured bio-physiological data. AL1 meant that the genetic algorithm was in use, AL2 meant that the annealing algorithm was applied. Both light periods ended with detailed testing.

After the de-installation of the whole system a concluding end test was carried out. It should measure the long-term effect of the ALADIN prototype. The whole field test finished with the focus groups. The distance between the end test and the focus group differed from test person to test person and ranges from several weeks to a few months.
3 Field work

The field work was carried out separately by each partner (APOLLIS, BLL, FHV, and LMU-MUENCHEN). A Field Test Manual (in German, as all the responsible partners were German-speaking) served as a common knowledge base about how the field tests had to be conducted (see Annex B). This comprised installation and initialisation which had to be organised by each partner and also the data collection which was carried out by the assistants.

3.1 Recruitment of test persons

The target group consisted in elderly people aged 65+ years living alone and fulfilling a list of inclusion and exclusion criteria specified in the Field Test Manual (see Annex B). Also the ethical and legal aspects such as insurance matters, the test person contract, the declaration of no ethical objection, and the gratification for the test persons (1.000 Euro or a TV set of similar value) were discussed and decided together.

When it came to the recruitment of suitable candidates each responsible partner of the field tests applied different strategies. The options ranged from press releases, help by gatekeepers and stakeholders like institutions and associations, advertisements up to personal contacts. The recruitment turned out to be complicated in the way that it was very difficult to find test persons who would fit perfectly the idea of the target group with beginning age-related restrictions. The younger, fitter, and technically more open minded elderly were more willing to participate in the project than the very elderly. Nevertheless in the end the recruitment was successful in all cases and 12 elderly singles, 10 women and two men aged between 64 and 82 years participated over the full period in the field tests.

The definition of appropriate test persons should have in mind the overall target group of the Aladin project but must respect certain practical exclusion criteria. The elderly person should live on his or her own, spend most of his or her time in the apartment or house and regularly watch TV, read newspapers, or perform some pastime activities in a particular room. The daylight situation in this room should possibly be such that the person normally needs artificial light for a specific period of time to perform their daily routines. On the one hand, the test persons should be mentally fit enough to make active use of the Aladin system, but on the other hand they should suffer from certain constraints such as limited mobility that prevent them from engaging in frequent outdoor activity in full sunlight.

For the field tests it was not feasible to adhere to these criteria strictly as there were other more practical aspects which had to be observed to ensure proper implementation. The main goal was to approximate laboratory conditions as closely as possible and to avoid distortions and side effects.
For this purpose, the following excluding factors were specified:

1. In connection with physiological signal registration:
   a. Serious cardiovascular illnesses e.g. pacemaker
   b. Serious neurological or psychiatric illnesses e.g. serious depression, epilepsy, severe dementia
   c. Serious hormonal illnesses
   d. Serious diabetes

2. In connection with visual disturbances:
   a. Serious state of cataract (beginning phase and already operated is allowed)
   b. Glaucoma (and other serious visual disturbances)

3. Other relevant problems and conditions:
   a. age-related mnemonic disturbances
   b. problems in falling asleep and suffering from sleep interruptions
   c. cancer

All excluding medical factors were based on individual judgment. Minor cardiovascular, neurological, hormonal, visual or other dysfunctions were acceptable.

3.2 Logistics and installation

For the 12 field tests, eight computer TV combinations and four light installations were available. These had to be transported from one location to the other and assembled flexibly according to the individual setup plans designed by BLL. This part of the field tests was organised individually by each partner. The transport of the devices and all the necessary material proved to be cost intensive when carried out by delivery companies therefore meetings in between were used to take the components from one partner to another.

The computer TV combination was installed by the partners themselves e.g. the assistant persons. Cables had to be put together and TV channels to be programmed. The replacement of the existing TV set was meant to assure technical compatibility of the input and output devices and to motivate the test persons through the constant presence of the ALADIN start menu. As a consequence the installation as well as the introduction phase were somewhat complex and required the help of an assistant. In any case the prototype was never meant to be a self-explaining plug and play device.

The luminaires were installed by professional electricians. In the initial phase of the field tests it turned out that the common knowledge base, the Test Manual, could not give answers to all the emerging questions, so an FAQ (frequently asked questions) was set up for all partners involved in the field tests.

3.3 Data collection

All the technical log data was regularly saved to backup files which were exchanged between the partners for control and preliminary analysis of the data. Some software updates were done to resolve minor problems. Concerning the questionnaire data the Field Test Manual lacked some information about when exactly to carry out the different surveys. So some of the instruments were applied too often, others too rarely. But after all the vast amount of valid data is more than sufficient to do the analysis. The instruments themselves were well explained in a detailed handbook provided by LMU-MUENCHEN.

All questionnaire data was consolidated by APOLLIS who also did the coding, input, and processing of data. Qualitative data including the personal diaries kept by the test persons was processed in the form of case histories (see annex).

Table 1 gives an overview of sample points and variable groups:
In the analysis of the objective effects of ALADIN prototype the dependent variables, that is the outcome in terms of well-being and mental fitness are clearly defined by the survey instruments used and the data collected. For this purpose we applied WHO-5, SEL, PSQI, and NAI. We have to take into consideration that the initial values of our sample were very high, i.e. test persons performed very well in the various psychological tests which did not leave much space for notable increase.

We transformed the test scales of these instruments to a 0 - 1 standard scale and looked at the test results of our 12 subjects we received before installing the ALADIN prototype. In Figure 5 we see that the mean values from all 12 subjects are in the upper third of this standard scale for all test results. The smallest test value we receive for WHO-5.

Table 2: Overview of sample points and survey instruments
3.4 Focus groups

Two focus groups of six and five test persons (TP2 missed the second focus group) were carried out after the field test (2008-09-02 at Bad Tölz and 2008-09-09 at Aldrans). The distance from the end of the field test up to the focus group differed so the impressions described by the test persons were sometimes „ fresher” and sometimes more „matured”. The focus groups did not only serve as an empirical instrument in order to collect qualitative data from the test persons but allowed also the exchange of experiences between the test persons.

The focus groups were meant to follow a roght guideline but at the same time allow free associations and open discussions. Both focus groups were guided by interviewers and assistant persons and they were recorded on video and audio, respectively. The guideline comprised the following questions:

- What were the test persons' impressions: did their mental fitness and well-being improve?
- What did they like and dislike (components)?
- Which improvements would be necessary? How could a future product look like?
- Were there any changes during or due to the field tests? What did their friends and relatives say?
- Could they imagine using such an improved system? Would they participate in other tests of AAL technologies?

3.5 Usability and accessibility optimization

FHV conducted iterative usability tests, in the form of both inspections by experts and end-user tests. The end-user tests were carried out with the HTML-dummy on a notebook computer of ALADIN with 12 seniors (65 - 84 years), with the first ALADIN prototype using tv and remote control with 10 seniors (65 - 94 years), and with 12 seniors (65 - 83 years) using an remote usability testing setup. The first two usability tests were done with German speaking seniors since the ALADIN prototype in the field test was to be tested with German speaking subjects from Austria, Germany, and Italy.

The last usability test was done remotely with seniors from Finland in order to include a target group from a European country with a high risk of seasonal affective disorder (SAD) or sleep disorders because of very limited light exposure in winter.

Additionally, continuous expert reviews were performed during the whole system development process with usability and accessibility experts from the User Centered technologies Research Institute at FHV.

Fig. 5: Initial test values (0 -1 standard scale) of the field test population (n=12) before installing the ALADIN prototype.
Fig. 6: Iterative usability and accessibility testing steps.

The feedback from expert reviews and end-user tests was continuously incorporated into the design and the development of ALADIN prototype. The tests comprised:
(a) the application for visualising people’s own psychophysiological data to make clear the connection between the psychophysiological indicators and people’s way of life and their mental and physical fitness
(b) the advice system that makes recommendations in accordance with the psychophysiological state of the test person
(c) the "classical" biofeedback application (e.g. control of heart rate by means of lighting and
(d) the GUI control for adjusting the overall system manually.

Usability tests of user interfaces were first performed in a laboratory setting with a representative sample of the population, which also implied equal participation of men and women. Once the feedback had been incorporated, the research results as implemented in the biofeedback systems were to be tested in real-life settings. The aim of all the usability tests was to achieve maximum user friendliness using design-for-all principles.

3.6 Lab experiments with ALADIN prototype

Field tests are very important to show long-term effects of the ALADIN prototype but have some limitations concerning the control of alternative influences on test subjects (e.g. different activities, different environments). For this reason we carried out an additional experimental lab test which was not foreseen in the description of work of the ALADIN project.

We applied a 4x6 test design with four lighting conditions and six exercises implemented in the ALADIN prototype. The light conditions were (a) static light, (b) random light, (c) light variations with genetic algorithm as in the field test, and (d) light variations with annealing algorithm as in the field test. The exercises were (a) calculating, (b), guessing, (c) reading, (d) memorizing, (e) EDA relaxation, and (f) HR relaxation. Test subjects (n=12) worked for 10 minutes with one of the exercises during one of the lighting conditions. All subjects were exposed to 4 x 6 conditions of the experimental lab tests in a random order.
4 Results

4.1 Functioning of the prototype

Basically the ALADIN prototype is composed of different components including a Mini Mac, a modern flat screen TV set, a programmable remote control, fluorescent tubes, a modern light control interface, and a biosignal transmitter. Since the single components and the system as a whole have very different characteristics we cannot compare the functionality between different components. So in the following paragraphs we want to discuss each component separately including the problems that occurred during the field tests:

The TV set sometimes did not switch automatically to the correct aspect ratios in which the programmes were broadcasted. It cannot be definitely concluded whether this is due to wrong signals or a defective TV set. It would have been possible to adjust the aspect ratio manually but of course the test persons could not be expected to use the internal menu of the new TV set. Another problem related to the TV but in reality a software problem was the fact that once switched on the TV without departing from the ALADIN main menu, but instead by using the buttons on the monitor or another remote control, you could not get back to the main menu because the software did not reckon that the user was watching TV. Since the software did not receive the ordinary command to switch on the TV ALADIN supposed it was still in active use and did not switch to the corresponding AV channel. The user had to activate the TV function again by the appropriate remote control and then switch back.

The lighting installation consisting of ceiling and wall luminaires, cables, Luxmate interface, light sensor, and a manual switch box was apart from installation problems initially free from any defects. All the desired light parameters could be easily reached and proved to go far beyond the subjectively needed range. Some test persons reported buzzing, flickering, or smelling, but this did not impair the correct operability of the light installation.
The sensor glove caused some troubles when first put on. The problems were due to the weak electro-dermal activity in the test persons' skin (which becomes drier with age), the limited reliability of the contact between the electrodes and the skin (e.g. through movements), and the high requirements of the software towards data quality during the initialisation of measurement. Changes in the software would have been risky because of the possibility of recording false signals, so in some cases the test persons helped themselves by pressing the electrodes to the skin or by moistening their hands before putting on the glove. However data transmission and the battery worked perfectly.

![Sensor glove](image)

Fig. 8: Sensor glove

The software started completely automatically and proved absolutely stable. Even after a blackout it would have booted up by itself. There were some minor usability problems due to the labelling of the menu which did not affect the operability of the system. A bug in one of the algorithms was quickly resolved by an upgrade.

Only two malfunctions influencing the interpretation of the field tests have to be mentioned:

1) There was a light sensor installed above the ceiling luminaire or in another position exposed to daylight in order to measure the current light situation. Though the light sensor was correctly connected to the bus box the software did not record the incoming signals from the sensor. So afterwards it was not possible to reconstruct the real light situation in the room where the automatic light adaptation took place. The only available variables to explain what might have been the effect of biosignal changes are the recorded parameters of the light devices. In the case of nocturnal exercises these parameters allow the reconstruction of the light situation, but exercises at daylight have to be analysed having in mind an unknown disturbing factor – the daylight entering through the window.

![Genetic Algorithm vs Annealing Algorithm](image)

Fig. 9: Range of used light parameters

Both algorithms (one more than the other) did not exhaust the range of possible and theoretically effective light situations. Instead they produced light within a much more limited
area which limits also the possibilities of analysis (Fig. 9). This may be the reason for the fact that the algorithms did not produce lighting parameters in line with the known lighting theory.

The adaptive algorithms of the automatic light adaption try to achieve personalized lighting situations defined by individual temporal and spatial variation of light intensity and light spectrum that are able to activate or to relax an elderly person. However, we look at the mean values of these light parameters (without taking into consideration the spatial variation) in order to check how the algorithms tried to find relaxing or activating lighting situations. Figure 10 shows these lighting parameters for both algorithms.

The lighting parameters differ considerably if we compare both algorithms for the relaxing and activating situations. Light intensity is nearly the same in relaxing and activating situation for the annealing algorithm, while it differs slightly in amplitude at the end of light adaption for the genetic algorithm. Light spectrum decreases at the end of light adaption in relaxing situations and increases in activating situations for both algorithm but much more for the annealing algorithm than for the genetic algorithm. According to these patterns we would argue that either light spectrum is the main factor for relaxing and activating people or we could suppose that genetic algorithm (with higher light intensity) is generally good for activating people and annealing algorithm (with high decrease of light intensity) is generally good for relaxing people.

![Fig. 10: Mean values of light parameters during automatic light adaption (n = 12).](image)

The Mini Mac did not produce noise or excessive heat and worked without problems. A minor inconvenience was the limited number of USB slots. The assistant had to disconnect one of the devices – preferably the light system – in order to connect keyboard and mouse for maintenance purposes. After that a reboot of the system was necessary.

Summary:
Overall the strategy to use „normal” products in an innovative way proved to be very adequate in terms of functionality. Future efforts to improve the system or even to make it ready for serial production can concentrate on the core functions like optimising the software, designing a less intrusive and more reliable sensor, and producing more cost-efficient lighting devices.

Besides, in the future it should be possible to make ALADIN compatible with any existing TV.

4.2 Effects on test persons’ wellbeing
In the analysis of the objective effects of the whole system the dependent variables, that is the outcome in terms of well-being and mental fitness are clearly defined by the survey instruments used and the data collected. Thereby we have to take into consideration quite high initial values which do not leave much space for notable increase.

Yet the definition of the independent input variables is much more complicated as we are not dealing with a laboratory test under controlled conditions but with a real life field test in which almost everything can happen and distort the assumed correlation between the application of the ALADIN components and the output. Besides a general Hawthorne effect, the fact that the situation of observing and surveying the test persons already has an effect on them, has to be taken into account (Adair 1984).

We can identify five sources of possible distortion and interference with the objective ALADIN effects:

- **Time effects**: The three months of testing with three intervals of three weeks are sensitive to time effects. We cannot exclude that the outcome measured in one period could be a consequence of a factor present in a former period. Only the sequence of adaptive lighting algorithms (genetic and annealing algorithm) could be rotated to control sequence effects. This does not affect the evaluation of the system as a whole but it influences the weighting of the different components and periods.

- **Learning effects**: Habituation and learning is in some way correlated to time effects and affects mainly our measurements of mental fitness. Concerning the performance in the activation exercises it is well known that regular training leads to improvements. So we should expect a notable increase in performance even without further supporting factors. In regard to the regular fitness tests (Nuremberg Age Inventory) we can almost exclude any learning effect because the tests were carried out too rarely but still we might consider a small habituation effect as the situation and the type of testing became more and more familiar with time.

- **Social support effects**: Coaching and assistance had to be a vital part of the field test because we could not expect the test persons to use the system on their own right from the start. We even knew from the preliminary study (Becker & Vanzo 2007) that technology which replaces social contact would be rejected. So social support was considered one of the main „disturbing” effects from the beginning. The problem is not that this effect exists, but that this effect is just as constant as human interaction can be. However some control is possible through the diaries and the annotations of the assistants.

- **Particular events**: Only in an isolated laboratory and under constant control can we exclude incidental distortions as they often happen in real life. In the analysis of the data we have to consider metereologic phenomena as well as illness or problems within social life etc. and we can only partly reconstruct them from the collected data.

- **Way of use**: A more interfering than distorting effect is closely correlated to the real life scenario. The test persons were free to use ALADIN like they wanted as long as they fulfilled some minimum criteria. That means that date, frequency and duration of usage of the different ALADIN components vary from test person to test person. This requires either some exacting modelling of the independent variables or a restriction to single case analysis.

Due to the possible distortion effects mentioned above and the low number of cases we do not want to attempt a multivariate full-factorial statistical model of the ALADIN effects. Instead we are going to present the single outcomes in a chronological perspective over the test periods taking into account the singularity of the 12 test persons. The interpretation of these results will then require a closer look with regard to subjective and qualitative data. In order to be able to
create first hypothesis on the impact of ALADIN components we applied some single non-parametric statistical tests taking into account Bonferroni/Dunn correction.

4.2.1 Improvement of well-being and quality of life

A look at the overall mean WHO5-Index for well-being (WHO-5 sum score) shows a significant increase over time from 60% in the baseline test up to 78% in the end test. This means that the test persons quite obviously benefited from the field tests or some element of it (Fig. 10). A closer look at the single cases reveals that only TP2, 5, and 7 show such a clear improvement over the whole test period. To this group we might add TP4 and 11 who departed from very high levels and still show some minor increase. A characteristic group is formed by TP6, 7, 8 who seemed to benefit mainly (or only) in a first moment with a rather constant or even declining level later on. And then we observe some cases for whom TP10 is the best example with a rather inconstant level of well-being.

![Well-being by test person and period](image)

Well-being by test person and period

A closer look at the single items of the WHO5-Index of well-being does not reveal a clearer pattern of improvement but makes the results look even more inconsistent. From qualitative data we deduce that the social support, the feeling of participating in something important which gives sense to life, and the continuous mental training through the activation exercises could be at least co-factors of the significant increase in well-being. In some test persons even the light installation and the hence improved light situation could have taken some effect. In the end we have to comfort us with the idea that ALADIN does really well but we still do not exactly understand how.

The same applies to our indicators of life quality, which show similar patterns but without indicating any significant increase (Fig. 11).
WHO-5 consists of 5 wellbeing items (happy & good mood, calm & relaxed, energetic & active, fresh & rested, life filled) and SEL consists of 6 dimensions (mood, health problems, health attitude, basic mood, social environment, life attitude). Most of these items resp. dimensions show an increase with the adaptive lighting algorithms, if we look at the mean values of all 12 subjects (Fig. 12 & 13). The mean results for WHO-5 items during five different field test phases show that the wellbeing of our sample became better with the ALADIN prototype. There are some increases in wellbeing after installing ALADIN prototype without the automatic light application. There are also some more increases in wellbeing after starting the automatic light adaption. Especially the item “fresh & rested “ shows an increase. An increase also occurs for the item “happy & good mood” together with automatic light adaption.
The SEL Life Quality Scales show very similar results (see Fig. 13). Most of the SEL Life Quality Scales show an increase of wellbeing without any time related effects. Especially, there is a positive change within basic mood after the automatic lighting with genetic algorithm was used, and a positive change within health attitude after the automatic lighting with annealing algorithm was used for three weeks.

Fig. 13: Mean results for SEL Life Quality Scales during five different field test periods (n=12).

Non-parametric statistical testing shows that mood of elderly is significantly better with adaptive lighting algorithms than at the beginning of the field test. A similar effect was statistically proven for health attitude with annealing algorithm and for “fresh & rested” with genetic algorithm. All the reported significances were calculated with Wilcoxon test and were Bonferroni/Dunn corrected.

Table 3: Statistically significant correlations between use of adaptive lighting and test items.

<table>
<thead>
<tr>
<th>WHO</th>
<th>happy &amp; good mood</th>
<th>calm &amp; relaxed</th>
<th>energetic &amp; active</th>
<th>fresh &amp; rested</th>
<th>life filled</th>
</tr>
</thead>
<tbody>
<tr>
<td>Frequency of Genetic Activation</td>
<td>0.693*</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Duration of Genetic Activation</td>
<td></td>
<td></td>
<td></td>
<td>0.616*</td>
<td></td>
</tr>
<tr>
<td>Frequency of Annealing Activation</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>0.578*</td>
</tr>
<tr>
<td>Duration of Annealing Activation</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>SEL</th>
<th>mood</th>
<th>health problems</th>
<th>health attitude</th>
<th>basic mood</th>
<th>life attitude</th>
</tr>
</thead>
<tbody>
<tr>
<td>Frequency of Genetic Activation</td>
<td>0.693*</td>
<td></td>
<td></td>
<td>0.842**</td>
<td>0.693*</td>
</tr>
<tr>
<td>Duration of Genetic Activation</td>
<td>0.605*</td>
<td></td>
<td></td>
<td>0.717**</td>
<td></td>
</tr>
</tbody>
</table>

Frequency and duration of using automatic light adaption shows some statistically significant positive correlation with wellbeing test items (Tab. 3). The more genetic algorithm was used the more the test persons were happy, energetic and had a good mood and positive life attitude. The more annealing algorithm was used the more the test persons were energetic and active.

**Hypothesis:**
The adaptive lighting algorithms of ALADIN prototype have a positive influence on the wellbeing of elderly people, especially on mood and individual relaxation.

### 4.2.2 Sleep quality

One of the typical discomforts increasing with age are sleep-related problems. Therefore the well-established Pittsburgh Sleep Quality Index PSQI was included in data collection even if we have to state that changes of sleep quality are rather long term phenomena that might not be susceptible to the application of light within the field test period. The overall mean value of 5.2 (SD=3.6) on an inverse scale from 0 „perfect sleep quality” to 21 „poor sleep quality” indicates a rather good sleep quality among the test persons. However the individual differences and the oscillations over time are notable. In TP3 and TP6 we observe irregular changes of about one third of the possible range.

On the other hand TP4 and TP8 enjoy such a sound sleep that improvement would have hardly been possible. In the other test persons we observe good or medium PSQI results with a slight tendency towards improvement, but the overall changes do not prove to be significant. Besides of the maybe too short field test period which does not allow the analysis of long term effects we must also consider a lack of systematic application of light due to the discretionary use by the test persons. For a therapeutical purpose the light-supported activation during the day would have to be scheduled based on medical examination as for example the serotonin level in the blood.

![Fig. 14: Sleep quality (PSQI) by test person and period](image)

PSQI has 19 items, nine of them asking for specific sleeping problems. These sleeping problems are: fell asleep after 30 minutes, woke up during night, went to bathroom, could not breathe during night, coughed/snored, felt too cold, felt too hot, had bad dreams, and had pain. Most of these items show a decrease with the adaptive lighting algorithms, if we look at the mean values of all 12 subjects (Fig. 15).
Sleep quality of our test subjects became better after the automatic lighting of ALADIN prototype was used. After installation of ALADIN prototype without the adaptive lighting algorithm we see almost no change in sleep quality. But after the automatic lighting with genetic algorithm was used the elderly test subjects fell asleep within a shorter time and did not woke up during night so much as without automatic lighting. This effect was not significant after Bonferroni/Dunn correction. We do not find these effects with the annealing algorithm.

Table 4: Statistically significant correlations between use of adaptive lighting and test items.

<table>
<thead>
<tr>
<th>PSQI</th>
<th>fell asleep &gt; 30 min</th>
<th>woke up during night</th>
<th>went to bathroom</th>
<th>couldn’t breathe</th>
<th>…..</th>
</tr>
</thead>
<tbody>
<tr>
<td>Frequency of Genetic Relaxation</td>
<td>-0.855*</td>
<td>-0.895*</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Duration of Genetic Relaxation</td>
<td>-0.578*</td>
<td>-0.857*</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Frequency of Annealing Relaxation</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Duration of Annealing Relaxation</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Frequency and duration of using automatic light adaption with genetic algorithm shows some statistically significant negative correlation with PSQI test items (Tab. 4). The more genetic algorithm was used the less the test persons woke up during night and the less they went to bathroom. In Figure 15 we see similar trends in mean values for the respective field test periods. There were no statistically significant correlations for the annealing algorithm.

**Hypothesis:**
The genetic lighting algorithm of ALADIN prototype has a positive influence on the sleep quality of elderly people, especially on falling asleep when required.

**4.2.3 Impact on mental fitness**
The regular fitness tests of the Nuremberg Age Inventory indicate some slight improvements over time (Fig. 16). While the image recall test is difficult to interpret because the normal score oscillates around six to seven memorised images and is strongly influenced by chance, the
number test (which measures the time a person needs to draw a line between numbers in ascending order) gives a more reliable result. There is a notable decrease from 27 to 20 seconds. However also in this case it is difficult to put the improvement down to particular factors.

**Mental fitness by test person and period**

![Graph showing mental fitness by test person and period](image)

Fig. 16: Mental fitness (NAI number test) by test person and period

We find similar results if we look at the mean values of all 12 subjects for the NAI (Fig. 17). The scores of picture recall test oscillates around six to seven memorised images - this is almost the maximum performance which can be detected by NAI. One number test shows the biggest increase after ALADIN prototype without adaptive lighting was installed, but this change could not be proved with statistical significance.

A statistically significant change, however, shows the second number test after genetic algorithm was used for adaptive lighting. This significance was calculated with Wilcoxon test and is Bonferroni/Dunn corrected. The maximum score of NAI number test was achieved with the end test which shows statistical significance compared with the baseline test.

Another way to check the impact of ALADIN prototype is to look at the results of the ALADIN activation and relaxation exercises. One major goal of applying ALADIN prototype is to receive better activation ability during cognitive performance exercises and better relaxation ability using biofeedback information. ALADIN prototype consists of four activation exercises (calculating, guessing, reading, memorizing) checking the cognitive performance of the elderly people and two relaxation exercises checking the ability to relax using electrodermal activity (EDA) or heart rate (HR) as biofeedback signal.
The analysis of the exercise results shows a significant increase of cognitive performance after using ALADIN automatic lighting with genetic algorithm and a significant increase of relaxation ability after using ALADIN automatic lighting with annealing algorithm. Figure 18 shows the number of correct answers and the percentage of relaxation. The increase in cognitive performance concerns calculating, guessing, and reading but not to memorizing. The increase in relaxation ability concerns heart rate biofeedback and not electrodermal activity biofeedback. All the reported significances were calculated with Wilcoxon test and were Bonferroni/Dunn corrected.

Frequency and duration of using automatic light adaption with genetic algorithm shows some statistically significant negative correlation with NAI test items. The more the genetic algorithm was used the more test persons could recall pictures ($r=0.577^*$) and the faster they were in number test ($r=0.620^*$). There were no statistically significant correlations for the annealing algorithm.

Fig. 17: Mean results for NAI Cognitive Performance Scales during five different field test periods (n=12).

Fig. 18: Mean results for ALADIN relaxation and activation exercises during three different field test periods (n=12).
When we look instead at the activation exercises and the scores yielded we have to consider strong learning effects because the exercises were continuously repeated. But in this case it was also the underlying intention to improve mental fitness by regular training. The objective effect is corroborated by the subjective impression of the test persons because most of them stated to have become much better with time. What is more they also understood the causal correlation between regular training and mental fitness. Of course the correlation between mental training and mental fitness is nothing new, but the field test has shown that effective regular mental training does not necessarily have to have the form of a fixed training schedule. Instead it can be included into assistive ambient technologies to motivate and encourage elderly users to engage in regular training.

As mentioned before, field tests are very important to show long-term effects of ALADIN prototype but have some limitations concerning control of alternative influences on test subjects. For this reason we decided to conduct an experimental lab test which go beyond the description of work of the ALADIN project. We applied a 4x6 test design with four lighting conditions and the six exercises implemented in the ALADIN prototype. The light conditions were (a) static light, (b) random light, (c) light variations with genetic algorithm as in the field test, and (d) light variations with annealing algorithm as in the field test. Further 12 test subjects worked for 10 minutes with one of the exercises during one of the lighting conditions. All subjects were exposed to 4 x 6 conditions of the experimental lab tests in a random order, so the sequence and learning effects are under control in lab test.

The results of the experimental lab tests show very similar results as in the field test, despite the fact, that we had different test subjects and different situations (Fig. 19). The analysis shows a significant increase of cognitive performance after using ALADIN automatic lighting with genetic algorithm and a significant increase of relaxation ability after using ALADIN automatic lighting with annealing algorithm. The increase in cognitive performance concerns to calculating and guessing but not to reading and memorizing. The increase in relaxation ability concerns to heart rate biofeedback and not to electrodermal activity biofeedback. Once more we see an decrease the relaxation ability use electrodermal activity biofeedback.

![Fig. 19: Mean results for ALADIN relaxation and activation exercises during experimental lab test (n=12).](image-url)
**Hypothesis:**
The genetic lighting algorithm of ALADIN prototype has a positive influence on the cognitive performance of elderly people, and the annealing lighting algorithm of ALADIN prototype has a positive influence on the relaxation ability of elderly people.

### 4.3 User acceptance and customer satisfaction

#### 4.3.1 Technical affinity

The test persons were neither a randomized nor a quoted sample but a group of elderly people curious and willing to participate in a scientific experiment dealing with modern technology. So we could not expect them to be absolutely representative for their age group. A look at the survey data proves that the possession and use of indicator items is disproportionately widespread. As we can see from figure 20 we have more users of mobile phones, computers, and home entertainment devices within our test group than within the target group we interviewed in South Tyrol in the preliminary phase of the project. So we may expect a higher level of acceptance and a more positive attitude towards technology in everyday life from our test persons.

Fig. 20: Technical affinity by means of indicator devices

#### 4.3.2 Attitude towards technology

Despite of the rather common use of technical devices in everyday life the test persons were rather sceptic when first confronted with the idea of the ALADIN field test. This concerned the installation of additional lighting devices as most of the test persons considered their own lamps completely sufficient, but also the use of a computer. But the apprehensions regarding the field test do not reflect the attitude towards technology in general.

From a short questionnaire containing some general items about modern technology and its use and usability we get a rather open-minded impression of the test persons (Fig. 21): They would not completely exclude support by technical devices in favour of receiving human help (3.6), they want to catch up with technological progress (5.0), they would like to explore their own body with modern sensor technology (5.0), and they believe in the positive effects of artificial light (4.8) (overall means on a scale from 1 „not true at all” to 7 „absolutely true”).

But there are also some doubts: the test persons are not very convinced that the participation in the field test will change their attitude (3.3), and the idea to buy such a system seems to be pretty remote (3.4).
Even if the field test period of about three months is a rather short time to have a profound impact on attitude and although we considered attitude more a constant precondition of acceptance than a changing variable, it is interesting to have a look at the development over time. Not in all the test persons it is possible to draw such a comparison but in a few cases including TP3, 4, 7, 8, 10, 11 and 12 we can state some notable findings:

From these seven test persons there were four who gradually lost their fear towards the complexity of technology. Four of them even felt that in the handling of a computer one actually need not be afraid of making mistakes. Five test persons even changed their opinions about computer games: Whereas at first they said they were only something for the younger they eventually felt that also the elderly could make good use of them. Nevertheless four test persons concluded after the field test that their attitude towards technology did not change as much as they would have expected in the beginning. Nevertheless, these changes have no statistic significance.

4.3.3 Acceptance of the ALADIN prototype

General remarks

Most of the test persons started into the field test with extensive personal assistance and a well-defined use schedule. The fact that even watching TV required the use of the ALADIN main menu led to a rather fast familiarisation with the system. ALADIN was „there” as a new member of the family. In some cases where the fear of complex technology was somewhat higher this was also perceived as somewhat of a nuisance because ALADIN could not be avoided. Individual coaching and a stepwise introduction of the functions made it possible to cope with this mental overload. In this context the decision to start the field test always with the AS phase, that is without light installation, turned out to be wise even though this limited its role as a control group (time effects). It also led to a predomination of the exercises as a vital function of ALADIN.

A look at the log data reveals a general increase of ALADIN usage over time. An increase in terms of use duration from the AS phase to the first AL phase (AL = with light installation) would be normal if we consider the longer lasting sessions of automatic light adaptation as active usage. However, we can also observe an increase from the first to the second AL phase, as well as an increase of the non light-bound functions. Only in some test persons as in TP3, 5, 6, and 8 we observe a usage peak in the middle of the field test with a decrease towards the end. Still these objective results cannot be taken as a general indicator for acceptance as we know that the test persons were absent sometimes and the motivation the assistants gave was not constant. Especially during the AL phases the assistants were told to motivate the test persons to use automatic lighting even at the cost of the exercises to ensure sufficient data for the evaluation of the algorithms.
Subjective data reveal better how the ALADIN prototype „hooked” the test persons and motivated them to increase usage. In the focus groups the test persons rather unanimously stated that the activation exercises elicited their ambition to improve and most of them noticed such an improvement and correlated it to the effort of their practicing. They had even fun playing the little games and wondered about the scoring criteria. Some test persons said that the success in the exercises was a good sign of their form of the day, so ALADIN served as a useful benchmark for fitness. Many agreed that even though they did not notice a significant improvement or did not see a correlation between their subjective fitness and the one measured by ALADIN, they felt at least motivated to train regularly because ALADIN sensitised their attitude toward their own mental capacities.

Some of them concluded that in the long run such a system or other types of brain jogging might really help to keep one's mind fit. The favourite exercise was where one had to guess whether there were more black or more white bullets on the screen. The reason for its popularity was the necessity of intuition and the often surprising results. The relaxation exercises would have been almost similarly popular if there had not been the necessity of putting on the sensor glove and the technical problems with data transmission of which we will talk later on. Also this function awakened the ambition to improve even though one might think that relaxation was not really achievable by effort. However some test persons even found out that it was pretty easy to outsmart the system by tensing one’s muscles artificially through physical effort before the exercise to obtain perfect results afterwards.

The special characteristic of the relaxation exercises highlights another motivating force for usage: Over time many test persons became aware that ALADIN and the continuous well-defined change of relaxation and activation helped them to structure their day. Some moments in everyday life which before would have been dedicated to unconscious resting now got a more concrete function, either to accelerate or to decelerate. As a consequence the ALADIN exercises became integrated firmly into the domestic life of most of the test persons and became a structuring element of their everyday routine.

**Lighting**

At first, the hardware components played a minor role concerning acceptance (except for some minor troubles with operability or usability which we talk about in the next chapter). This changed with the installation of the lighting devices which caused a deep visual impact in the households even when not switched on. In the eyes of many test persons the design of the luminaires did not go well with their furniture and the devices looked clumsy and over-sized. On the other hand the test persons knew that this would be a field test with a prototype and that a future product would look very different. However the prominent lamps raised high expectations concerning their functionality.
As most of the existing lighting devices were replaced by the new ALADIN luminaires the test persons had to use at least the manual light adaptation from the first day on. And they soon got used to the external switchbox and to the adaptation via remote control. Also this introductory phase was accompanied by the assistants, e.g. in order to programme some suitable presettings for illumination, and in the course of this customisation the test persons got to know the full capacity of the luminaires. Concerning the acceptance of manual light control one of the preliminary hypothesis was easily corroborated: Those who experience excellent lighting do not want to turn back to lesser light. Even though many customised presettings were dimmed down for a more relaxing light atmosphere, like e.g. watching TV, there was always at least one frequently used preset which literally outshone the maximum light amount available before the installation.

![Image](image_url)

**Fig. 23:** Individual use frequency of automatic light adaption (activating and relaxing light) during field test periods with genetic and annealing algorithm.

In regard to the acceptance of automatic light adaptation we face a somehow theoretical problem: You can only accept what you really perceive. Due to the subliminal changes of the light parameters (disturbing exceptions are treated in the following chapters) the automatic light adaptation did not differ much from the manual light control – at least in the eyes of the test persons, yet they were obliged to wear the sensor glove and should not leave the room. As the automatic light adaptation was neither an activity nor seemed to „happen“ and did not give any feedback about the results, the usage of this function was perceived as a duty rather than a pleasure and could not meet their high expectations. Even in the long run most of the test persons did not notice any positive or negative effect on their well-being or mental fitness.

**Other components**

Data about handling troubles and easiness of use were collected by questionnaire in quantitative form, by assistants in the form of informal interviews and in the course of the focus groups. We have to distinguish between the usability of the common components as the TV set and the remote control, the particular hardware components as the switchbox and the sensor glove, and the most vital part of man-machine communication: the software-based user interface.

As the functionality of the **TV set** was reduced to the functions accessible by the new remote control there could hardly be any operability troubles. We can only mention some occasional problems with the automatic switching of the AV-input, so that the test persons had to control it manually via the AV-button on the remote control. A few test persons missed some functions they used before like adjusting the brightness or the colours. So for a future outline one should think about an add-on solution to the existing TV set.

The **remote control** itself was mostly employed by pressing the number buttons rather than using the cursor keys. This corresponds to the general use patterns revealed in the preliminary study. There were some minor handling problems due to jammed buttons and slow response, but this was more a matter of subjective preferences.
Whereas the switchbox largely resembled an ordinary light switch so that it could not be misused, the sensor glove required some practice to put on. In terms of operability, the data transmission problems and the confusion produced hereby is not the fault of the glove. But the electronic device could maybe have given some hint about current transmission status and battery charge just to inform the test persons what was going on. Also the fact that the device had to be switched on separately including for re-charging was at least in the beginning confusing for test persons and assistants.

**Summary:**

In a setup like ours where independent individuals actively use technology according to their needs, a feature the effect of which is not immediately obvious and perceptible such as adaptive lighting is problematic. We must not forget that this would change completely given a passive care situation with continuous and low-impact sensor control and the possibility to provide automatic light throughout the whole day. What concerns our field tests we can conclude that some of the test persons had to be motivated to use automatic light adaptation even if they did not see the point of it.

It is difficult to draw general conclusions about the acceptance of an ALADIN-like system in terms of the marketability of a product. In the field tests ALADIN was seen as a prototype and various malfunctions were “forgiven”. Due to the social and technical support that came with the prototype it quickly became a constant element of everyday life. Nevertheless most test persons did not seem to miss it too much afterwards. A remarkable result is certainly that ALADIN was not perceived as one integrated system, but in the eyes of the test persons there were two: an interactive gaming computer and a powerful lamp. The „missing link” had to do with the imperceptible automatic light adaptation on the one hand, but on the other hand may have been induced by the manner in which the system was introduced and communicated.

### 4.3.4 Usability of the ALADIN prototype

Usability optimisation was performed in an iterative way in the form of both inspections by experts and end-user tests. The feedback from expert reviews and end-user tests was continuously incorporated into the design and the development of ALADIN prototype.

**HTML dummy lab testing (June 2007)**

The first usability test with 12 seniors (65 - 84 years) was conducted with a HTML dummy to examine the screen design of the ALADIN prototype controlled by a remote control unit. The results showed that most test person used the number keys of the remote control. The segmentation of the screen with title, text, picture, and navigation (Fig. 24) was described as very clear.

![Fig. 24: Segmentation of the ALADIN prototype screen.](image)
After a short introduction to the system only the 84 year old test person had problems with navigation. Most of them had no particular suggestions for the navigation: they always could explain their own position within the whole ALADIN software structure and were able to return to the starting point. Test person preferred white text colour and blue background colour. The software should give immediate feedback after every user input which was not implemented for all ALADIN components. For instance, after using the manual lighting option the system turned back to the starting menu without any feedback about the executed action of the software. Text information should be as short as possible. Test person were not interested in history information for more than seven days.

Mock-up lab testing (October 2007)

For mock-up lab testing the first ALADIN prototype with TV and remote control was used by 10 seniors (65 - 94 years). The results emphasize that graphic design should contain clearly structured text in the content area (i.e. use of bold), avoid capitalized letters within words, and increase size of numbers for menu selection. Special care should be taken to make the start screen of the ALADIN prototype pleasing, so that it invites further exploration. The information in the navigation area should be sufficient for operating the system.

Besides, navigation elements should pay close attention to consistency (same structure, same words), point out navigation possibilities by pressing numbers, provide feedback about ongoing processes (e.g. in Biofeedback), and ignore accidentally repeated button presses of the remote control. Wording of ALADIN prototype should be brief and concise (e.g. „Glove”), each screen should be comprehensible on its own, and visualizations should closely relate to the given text (e.g. in exercise results). Answers of ALADIN should clearly respond to questions and feedback should be given in positive terms where possible (e.g. in exercise results). It is important to keep wording consistent and to introduce no new symbols and icons on deeper levels. The structure of content should be as flat as possible and consistent (Fig. 25).

Test persons were using all applications: automatic light adaption, manual light, exercises, advice, history, and television. Exercises consist of two relaxation exercises (heart rate and electrodermal activity feedback) and four activation exercises (calculating, guessing, reading, and memorizing). Figure 26 shows the mean results from all 10 test persons for all exercises. Mean time graph of electrodermal activity and heart rate shows a clear decrease of these parameters in time indicating psychophysiological relaxation. Mean results of activation exercises shows that all exercises have nearly the same level of complexity. Calculating will become more complex if we add a third mathematical operator.
Prototype field test (February - August 2008)

Overall, the GUI of the final ALADIN prototype, i.e. the graphic user interface, was described as very easy to use. However there were some aspects which caused problems. One was that certain functions were added after the light installation and inserted into the menu options so that the numeration of options changed. Users who navigate by cursor buttons would not even have noticed it, but some of the test persons who had learned the corresponding number keys by rote became confused. Another interesting phenomenon was the moments in which the test persons did not know whose turn it was, whether ALADIN should do something or was doing something or whether they should give some input to keep ALADIN going. This phenomenon was observed on higher levels of the menu where a direct change of options was not possible, instead the test persons had to scroll forward through the options and sometimes forgot about this. It was also observed when the sensor glove was not put on or did not work and the menu required to undertake some action without telling to press start again.

Testing of ALADIN prototype by Finnish test persons (December 2008)

During the winter semester of 2008 two Finnish students expressed an interest in becoming involved in the ALADIN project. This offered a great opportunity to test the prototype with people outside the realm of the German-speaking countries where the field tests had been conducted. Besides, the fact that the students originated in a country with widespread seasonal depression due to lack of sunshine made this opportunity particularly attractive.

The testing falls into two categories:
1. Expert reviews carried out by the students
2. End-user tests conducted at their home university (Jyväskylä University of Applied Sciences)

Both students were familiar with the basics of usability and human-interaction research and carried out a heuristic inspection of the prototype. This provided them with an understanding of the different ALADIN functions and was an excellent preparation for the remote usability test which was their main assignment.

The remote test took place in the laboratory of wellness technology of Jyväskylä University of Applied Sciences and was moderated by one of the professors who acted as a facilitator. Before conducting the test with three test persons (average age: 70 years) he received extensive information about the ALADIN project and the prototype. The IT experts at UCT provided instructions about how to install remote access so the test persons could navigate the system on a computer screen. Both the expert reviews and remote end-user tests focused on the GUI of the ALADIN prototype and used the English version of the prototype.

The results do not differ much from the user testing carried out with German-speaking test persons in Austria, German and the South Tyrol. All test persons agreed that the ALADIN application was well designed and fulfilled the accessibility criteria defined in advance. Navigation was considered clear and straight-forward. The user interface as a whole was perceived as “serene, clear and logical”. ¹

The most striking difference was the fact that the Finnish test persons liked the smiling avatar. In the expert inspection they even felt that it was so engaging it might distract the user! In the end-user tests some comprehensibility problems were encountered, e.g. with terms such as “browse” or “advice”). These were probably related to an insufficient knowledge of English rather than the wording of the screen menu. Actually, finding test persons with a good command of English turned out to be the biggest challenge when organising the tests in Finland.

Similarly, other problems that were encountered were related to the remote testing situation rather than to the prototype itself: some test persons, for example, had difficulty in seeing the cursor. Whereas in on-site testing people used a remote control, in remote testing they had to use a mouse.

An interesting observation was that Finnish test persons seemed to be more familiar with this type of application and felt that ALADIN needed more features to truly stand out.

**Summary:**

As far as the minor usability problems with the GUI of our final ALADIN prototype are concerned, these can be avoided in the future by adopting the following measures:

- a clear signal when ALADIN is busy and the only command users can give is to stop (e.g. an hour glass),
- another clear signal when ALADIN is awaiting a user input to take action (e.g. pop-up), and
- strict correspondence between the options given (questions) and the possible alternatives (answers).

### 4.3.5 Customer satisfaction

The subjective rating of the test persons of the different ALADIN components may be of questionable value for the evaluation of the field test because test persons tend to criticise secondary aspects of a prototype which will be changed anyway when producing a marketable version. But even criticism of small details gives valuable insights for future redesign and further development. And what is more: we get more insights into how our target group thinks and feels.

¹ Quoted from the report submitted by the students.
Customer satisfaction was examined repeatedly by a short questionnaire where the test persons were asked to give marks to the single components. The differences between the test persons but even more the fluctuations over time show that subjective valuation correlates with knowledge and habituation. In some cases new functions which were not yet internalised received worse marks just because they still seemed too complicated. Others received decreasing ratings maybe as an effect of familiarisation and boredom. These individual differences are difficult to explain with quantitative data, so at this stage we want to give an overview of the subjective ratings:

![Subjective ratings](image)

**Fig. 27: Subjective ratings (means over all test persons and periods)**

As we can see from figure 27, the light installation received best marks in terms of brightness and light quality, and the user interface stuck out with the easiness of number key navigation and the general design. More modest, but still satisfactory ratings were given to the history and the advice function. The rating of the relaxing automatic light adaptation was rather poor.

Regarding the light devices nearly everybody admitted that the power and the quality of the light was almost awesome. The main points of criticism were aesthetic objections concerning the design of the luminaires. Some test persons criticised also buzzing, smelling and flickering. While most of the test persons liked the emitted light, some of them found it too bright or too cold and it made them think of surgery rooms or factory halls.

During the first advice-only phase, high expectations were raised with regard to the automatic light adaptation. It may therefore be not that surprising that it was often rated as disappointing. Some test persons said that the automatic adaptation behaved uncontrollably and changed the light situation too abruptly, others did not perceive any change at all and thought it would not work. A very common point of negative criticism was the start value of the automatic light which was not the current light situation but a random value which led to a sudden change when the current situation was very different. Especially when departing from a rather dusky situation with the aim of relaxing this seemed rather contradictory to the test persons. The sessions of automatic light were also affected by some other phenomena which had their origins in the software and the sensor glove. Once switched on the automatic adaptation the test persons could not leave the room without interrupting the session due to the break-down of the data transmission.

The TV screen received generally good marks, however most of the test persons would prefer their old ones. Aspect ratio switching, brilliance of image, and audio quality were rated inferior to the personal TV set. But this concerned mainly its function to watch TV. As a graphic user interface it got very good ratings from the test persons: The colours, the menu design and the navigation were well approved by most of the test persons. In some screens the font size could
have been larger, but the colours, the design of the symbols and also the avatar were rated as positive, even though the latter was often blamed as stupid when malfunctions occurred. Many test persons stated that the friendly design of the user interface and the direct feedback motivated them a lot to do the exercises regularly.

From the perspective of the test persons the activation exercises were the highlight of the whole system. The only trouble was that the exercises became too easy with time and of course the choice of possible games could have been larger. The relaxation exercises had also the potential to be well approved, but they required the use of the sensor glove which unfortunately did not always work well. In general the test persons liked the relaxing music which was played and found it interesting to watch their own heart beat displayed on the screen. However on some occasions there was a gap between the feedback given and the subjective feeling of the test persons. Pretty often the elderly users had the sensation that they had relaxed very well, but ALADIN told them the contrary. For such reasons many test persons were interested in the criteria which were applied by the system to judge them like this and they wished a more accurate feedback and a more detailed history function. This was also the reason why the advice function was rated rather badly: as almost all the test persons reached very good scores in both types of exercises, no advice was given except for an affirmation that everything was ok.

The sensor glove and the remote control were the most „physical” components of the ALADIN setup, so the sensual quality played an important role. The remote control had a rubber body and keys the touch of which some test persons did not like. Besides, some keys seemed to jam and delayed the commands in the activation exercises. The sensor glove was delivered in one size fits all and especially some women with smaller hands complained that the glove did not really fit. Others said the glove caused numb fingers or that it could not be washed. But the most frequent criticism was related to the difficulties to get the data transmission going. From the perspective of the test persons the glove was one of the weakest parts of the system, and this confirms one of the findings of the preliminary study that intrusive sensor technology is a crucial aspect of assistive ambient technologies.
5 Conclusions

The real life field testing of the ALADIN has provided us with a vast amount of data concerning the factors of well-being and mental fitness in an ageing population and the potential effects of ambient lighting assistance. Even if the sample was small and therefore statistically not significant we gathered very valuable information for advancing the use of lighting for better ageing and improving well-being. The concrete conclusions which can be derived from the testing in real-life settings can be roughly divided into:

1. Ideas about how to improve the ALADIN prototype and its different components
2. Ideas about how we can still improve the process of testing
3. Ideas about where further scientific research is still needed.

In general and besides of the teething troubles of the prototype the test persons were rather satisfied with the ALADIN system and the field tests they had participated in. The installation seemed to them a promising idea even though they perceived it as two separate products in one: a funny solo-game partner who gives direct and nice feedback and motivates them to engage in mental training and proactive relaxation and an awesome light system which makes excellent light for all purposes of life. Also, the field tests were of course also a great opportunity to broaden one's horizon and to get to know new people.

5.1 Possible improvements concerning the prototype

A marketable version of ALADIN is certainly still some years away, but the field test helped us to gather many proposals for improvement. As the prototype was not perceived as one integrated system but as a set of valuable components we may consider separating the components and taking them to the market separately as well.

This brings us back to the discussion about the target group which could be quite different for each function, module, or component. We have learned that mental fitness training would be an activity the younger elderly could be really fond of. In comparison to products which are already on the market (Nintendo for the elderly), ALADIN’s sensor technology and its integration into ambient assisted living (AAL) applications could be an option worth considering. The social embedding of AAL applications has turned out to be of great importance.

On the other hand we see an automatic lighting adaptation to enhance well-being and stabilise the circadian rhythm which may be more suitable in cases where the elderly are already constrained to such a degree that taking action on their own is no longer possible. We would then have to devise strategies to reach the relevant intermediaries such as health and care professionals, care organizations, building companies and housing associations.

From the results of the field tests many concrete improvements concerning the ALADIN outline can be derived. One vital aspect is the importance of improving sensor technology. We have to find even less intrusive devices to collect real-time biosignals. ALADIN can only be marketable if the sensor glove is redesigned taking into account the feedback of the test persons or if a finger ring or a wristband can be used for signal capturing.

When it comes to the light installation we have to find a much cheaper, more stylish and less awesome solution. However, this may conflict with the requirements of miniaturisation, camouflage or aesthetic integration. Older people are also very concerned about energy consumption which is why the use of LEDs continues to be an issue. Some minor difficulties with usability and compatibility with home entertainment equipment could be avoided if ALADIN were connectable to any TV set as a plug-and-play device. In this case the remote control could be even simpler.

A last remark concerns a basic insight of market research: Products and their features have to give a clearly visible benefit to the customer. In the case of ALADIN it was the automatic light adaptation which lacked this benefit at least at first sight even if it took effect in the long run. So
some additional features e.g. like a light timer in absence to scare off burglars, automatic switch-off as an energy saving measure, automatic switch-on by a movement sensor for more comfort, or an automatic navigation help for a safe nocturnal walk to the toilet could as well constitute a „wonder lamp” as the much more sophisticated, but subjectively less apparent function of automatic light adaptation.

5.2 Possible improvements concerning the field tests

As is usually the case with such complex endeavours that consume lots of time and human resources, one would like to have another go to get everything right straight from the start. This is why it is so important to derive lessons learned from one’s experience. Clustering events that encourage the exchange among projects with similar objectives are one of the ways to pass them on.

An important lesson learned is that even if you assume that you have prepared the field trials very well, cleared all the ethical issues, organised the logistics and written up detailed instructions for those who have to implement the system and run the tests, this does not ensure that they will run smoothly. There seems to be a tendency to prefer calling on a human person/expert rather than consult the manual or FAQs on the Web. Therefore, a need for central coordination throughout the field trials has emerged to take account of the wide-spread push rather than pull attitude.

Another important lesson learned is that for measuring factors such as wellbeing, sleep quality and attitude to life the field trials should last for a whole year. This would also help neutralize the novelty effect in the beginning. In the focus group discussions, in particular, it became clear that the test persons who used ALADIN in the winter months were overall more positive than the ones who used it in spring. Whilst we were aware of this, the high costs of the lighting system made this impossible. Having three systems run in parallel was the most we could afford.

We found that we did not always succeed in getting across the message. Many test persons felt, for instance, that the avatar did not really reflect whether they felt relaxed or not. It might be better to just use a graph or curve to indicate increasing or decreasing relaxation. Besides, it might be useful to ask people to start out with activation to establish a baseline for each day.

The need for very precise instructions does not only apply to the test persons but also to the assistants and the people involved in installing the system. Although before the field tests detailed manuals for the organisations and the coaches involved in the field trials had been prepared, discussed and distributed to all the relevant parties, this still proved insufficient. Especially, we underestimated the need for technical assistance for installing the system. Since we cannot assume that those in charge have a certain degree of technical understanding, it might be preferable to appoint one expert to handle the installation in all the locations.

5.3 Need for further research

One of the basic findings of the field tests is certainly that there is still much research to do. But then, isn’t research all about raising questions and formulating hypotheses rather than finding answers?

In all future developments that build on the ALADIN project we must emphasise its USP (unique selling point), which is user- and situation-specific personalisation and customisation. This is one of the outstanding features that distinguish our solution from the other lighting offerings available on the market. However, with the ambient lighting solutions available on the market the user has no possibility to interact with the predefined control strategy (mostly defined by the time of the day or the function of the room) and the lighting solutions do not take into account individual and situation-specific differences. Our solution, however, can be tailored to the individuals and their environment by capturing sleep and activity/movement patterns as well as psycho-physiological parameters such as skin conductance or heart rate.

Based on the preliminary findings of our field trials and many discussions we have had with experts as well as representatives of our end-users, the following avenues look promising:
5.3.1 Package technology with social support measures

It has been shown clearly that technology can only complement but never replace interaction with humans. Although the great majority of the elderly want to live independently at home for as long as possible, they nevertheless want to be embedded in a social network. In a follow-up project we would like to investigate how this type of support can best be delivered. LMU, for instance, might use SOPHIA, an information and communication platform developed by a housing foundation (Joseph-Stiftung) together with the university and clinic in Bamberg (see www.sophia-tv.de). Via a videophone this ‘virtual nursing home’ connects people to a large variety of health and care as well as social services in the region.

5.3.2 Package technology with advice on ageing-friendly housing

In the course of ALADIN we have acquired a great deal of knowledge about older people’s needs and preferences with regard to housing. Due to mobility constraints, many older people spend a large proportion of their time indoors, which makes optimising lighting so essential for their wellbeing. Lack of daylight may cause seasonal depression and sleep disorders due to irregular circadian rhythms. This can be compensated by longer exposure to light during winter times and higher illumination levels in general since with ageing people’s vision tends to deteriorate. Besides, lights should be dimmable to enable adaptation to the time of day and thus reduce energy consumption.

When installing lighting systems in the homes of the elderly, quantity, spectrum, timing, duration and spatial distribution are important characteristics to be considered. In addition, special age-related impairments such as impaired vision have to be taken into account. In the empirical research for ALADIN, the risk of falling down emerged as one of the most common worries among the elderly. The use of lighting for navigational purposes therefore would clearly respond to older people’s needs. Besides, a future lighting solution would have to address safety and security concerns, e.g. as a protection against burglary or theft.

Another interesting avenue to pursue is the use of light for alleviating mild cognitive impairments such as loss of memory that may signal the oncome of dementia. BLL are collaborating with the Medical University of Innsbruck to investigate how to optimise lighting in this respect. They may prepare a proposal on this topic for the AAL Joint Programme.

In future, we would like to use our knowledge in ageing-friendly housing by joining the growing network of experts and consultants in this field, including the Swiss Centre for Accessible Building (http://www.hindernisfrei-bauen.ch/) or the Sonnweid Foundation (www.stiftung-sonnweid.ch) with a focus on dementia.

Finally, in the course of the fieldwork we found that a field test resembles to some extent a space mission which serves as a container for research purposes and experiments of various parties and that the agenda is rather „stuffed”. So for a re-edition it would be important to balance the different requirements even better.
References


Annex A. Brief case stories

Test Person 1

Personal profile: Mr TP1 is 65 years old and lives in his own house situated in Aldrans, a town south of Innsbruck Austria. His house is relatively large with 3 floors. He lives alone.
Mr TP1 learned electrical engineering. He looked after his family, his house and his garden. He is very active and skilled, so it is normal for him to repair the roof of his house by himself. He is also relative athletic and likes to go to the mountains, but he has problems with hip pain. He socialises quite a lot with his friends. Periodically he baby-sits his grandchildren. He has no problems with sleep.

Motivation for participating in the ALADIN field test: Interest in science

The time with ALADIN: Mr TP1 is an early riser. Usually he gets up at 7:30 and eats breakfast, he performs a relaxation exercise and another exercise for activation with ALADIN. Overall, Mr TP1 enjoyed participating in the field test. He was very relaxed when problems occurred with the system and he was interested in details of problems. The sensor glove produced sometimes invalid data and the scores and responses did not always correspond to his feeling of the exercises.
Sometimes the structured time schedule of ALADIN did not fit to his active, unrhythmic life. So whenever the time fitted, he did the ALADIN exercises. He tested the adaptive lighting, but did not feel the promised advantages. Because of missing feedback, he did not do many exercises with the automatic light.
Due to his vast activities Mr TP1 has quite a full agenda every day and he is mostly outside. At the time he has no need neither for assistance nor for a system like ALADIN. He just enjoyed the high amount of light and the possible manual light settings. The main advantage in his eyes, was the quality of light.

Test Person 2

Personal profile: Mrs TP2 is 78 years old and lives in her own house situated in Aldrans, a town south of Innsbruck, Austria. Her house is relatively large with 200m² on 2 floors. She lives alone.
Mrs TP2 learned accounting and worked at her husband's company. She looked after her family, her house and her garden. She benefits now from her good over-all health condition. She is very active and it is normal for her to clean her large windows ascending a ladder. She makes many trips with friends and the local senior citizen organisation.
In the time before and during the field tests, she had to organise the sale of her house in Aldrans and moving to her son to Vienna. In the past such tasks had been done by her husband and now she had to do it by herself. It was a great challenge for her and resulted in perturbation and a high stress level. In addition she had to give away most of her beloved belongings, which was very hard for her.

Motivation for participating in the ALADIN field test: She was very interested in the brain activity exercises and she wanted to benefit from the relaxation exercises.

The time with ALADIN: Mrs TP2 is an early riser. Usually she gets up at 8:00 and after breakfast, she performs a relaxation exercise and another exercise for activation with ALADIN. After an intensive day she takes a hot shower and enjoys a good night’s sleep.
Overall, Mrs TP2 enjoyed participating in the field test. She was very relaxed as problems occurred with the system. The sensor glove produced invalid data in the beginning and scores and responses did not correspond to her subjective feelings about the exercises.
The structured time schedule of ALADIN helped her to make her day and keep some extra time for conscious relaxation.
The periodicity of activation and relaxation through the exercises seemed to her the biggest advantage of the system. And she enjoyed the improvement of her scores in the activation exercises. She also tested the adaptive lighting, but her activities are situated in every room of the...
house and not only in the living room, where the ALADIN system was installed. And when she used the adaptive lighting, she did not feel the promised advantages, because of irritating light actions and missing feedback.

Mrs TP2 was not very interested in details of the system. She had some problems handling the ALADIN remote control, finding her preferred TV program and finding the ALADIN manual lights „off” function.

Due to her high activity level Mrs TP2 has a full to-do-list and she runs through and around the house every day. At the time she had no need for assistance, but due to her age, she agreed to move to Vienna to her son. She enjoyed the high amount of light of the ALADIN light systems and the positive effects. The main advantages in her case are the activation exercises and the organised free time for relaxation.

**Test Person 3**

**Personal profile:** Ms TP3 was born 66 years ago as the first child, her only brother was born two years later. The two children grew up with their mother in a small town in the West of Austria. After school she worked in a local textile factory and in the town hall until she got married at the age of 24. She moved with her husband to their own house to a village nearby, where she focused on raising her three daughters.

When her children left home she wanted to work again but at that time her husband fell seriously ill. Therefore Ms TP3 had to stay at home and care for her husband. His condition got worse and some years later he was wheelchair-bound until he died one year ago. She is in regular contact with her daughters and looks after her only grand-daughter once a week. Besides she has a number of friends whom she got to know mainly through her volunteer work.

**Motivation for participating in the ALADIN field test:** Ms TP3 has a very open mind and is interested in new technologies. Furthermore she is very interested in the quality of light.

**The time with ALADIN:** Ms TP3 gets up at about 7:00 and performs two ALADIN-exercises: relaxation and activation. She sometimes wonders about the feedback for relaxation – ALADIN tells her that she was not able not relax well although she feels totally relaxed. She tries to avoid the mathematical exercise but likes the other possibilities to activate her mind quite a lot.

After breakfast Ms TP3 tidies up the house – often with some help from the mobile emergency service because her back is starting to hurt when she stresses it too much. After lunch she usually sleeps for half an hour to gain new strength for the afternoon. Sometimes she uses the ALADIN exercises before her little nap to get relaxed, sometimes she uses the system to activate herself afterwards. When the weather is fine she goes for a walk with friends. Another important thing is garden work. Especially on warmer days in spring she spends a lot of time in her garden.

In the evening Ms TP3 likes to visit cultural events like the opera or theatre but most of the time the she stays at home and reads a novel or watches TV. With the adaptive lighting of ALADIN she spends quite some time in front of her TV set – actually more often than without the system. Before going to sleep, she performs the exercises at about half past ten.

At least once a week the typical day looks a little bit different. Ms TP3 takes care of her only granddaughter from morning to evening and sometimes over night. She does some exercise with the child and of course plays a lot with her. But she never forgets to use her ALADIN-system three times a day.

Overall Ms TP3 enjoyed the ALADIN system – she was especially happy about the high quality of the light devices. In her opinion the light was very appealing and bright but she wished that the devices themselves were less big and did not change the visual appearance of the room that much.

The most annoying part of the system was the TV set that firstly often failed to react to the IR remote power button and secondly was not able to switch between 4:3 and 16:9 screen ratios. The rest of the system ran totally smoothly, a restart of ALADIN was necessary only once.

The most positive effect of ALADIN was the structuring of the day. Although the exercises took some time she was seldom weary to do them. Especially the word memory-exercise was fun for her and even made her looking forward to using ALADIN sometimes. The relaxing part of
ALADIN made her sit down and relax much more consciously but the repeated negative feedback was quite annoying.

Ms TP3 does not need any assistance at the moment because she is totally fit mentally and has only minor physical problems. However she might consider using assistive technologies when/if she needs them.

Test Person 4

**Personal profile:** Ms TP4 is 65 years old and lives in her own house situated at the outskirts of Feldkirch, a town in the West of Austria. She has been living on her own in a big house for several years. Apart from her siblings (3 sisters and 1 brother) her immediate family includes her two grown-up daughters and their children as well as her 88 year-old mother who is still living independently in a village nearby.

Ms TP4 worked as a nurse until she had her first child. For 25 years she looked after her family, their house and garden. It was only when her children got older that she went back to paid work. In the last few years before retirement, she was in charge of a nursing home for the elderly. She is therefore well aware of the problems that tend to occur in advanced age. She strongly believes that it is important to give meaning to one’s life, e.g. by helping others, and by being embedded in a social network. In her opinion, these factors help one cope with any physical impairments that may arise as a result of ageing.

**Motivation for participating in the ALADIN field test:** Curiosity.

**The time with ALADIN:** Ms TP4 is an early riser. She gets up at 6:30 and before breakfast, performs a relaxation exercise and another exercise for activation. She normally achieves a very high score in the memory exercise. However, she is not content with activating her mind. She regularly attends exercise classes to keep herself fit. After breakfast she tidies up the kitchen, goes shopping and prepares lunch. Sometimes she is expecting a friend to join her for a brief walk in the sun after lunch. In the afternoon she goes to see her mother who lives about fifteen kilometres from her home. Especially in winter, they often play cards together. Sometimes her mother's neighbours also join the game or she helps her mother with various tasks that the older woman finds increasingly difficult to perform due to pains in her joints. In the evening Ms TP4 has a modest supper and then takes out her vocabulary book. She has been studying Modern Greek for several weeks now because she is planning a trip to Greece in the following summer. She switches on the automatic lighting of the ALADIN prototype to assist her with memorising the new terms. Before going to bed, Ms TP4 uses the biofeedback application to help her relax. Before falling asleep she says grace for having been granted another fulfilled day and then enjoys a good night’s sleep.

Overall, Ms TP4 enjoyed participating in the field test despite the teething problems at the beginning of the trial. The lighting installations did not work properly at first, the sensor glove did not produce clear readings and one of the lamps kept making buzzing noises. But all these problems were solved and her suggestions about how to improve the system were all incorporated in the re-design. She felt that the system helped her gain a better understanding of her state of mind and how it is influenced by environmental factors. Not surprisingly, given her active lifestyle, she found it much easier to activate herself than to relax, at least at the outset. An unexpected side-effect was the way the ALADIN system contributed to the structuring of the day. Being recently retired, this was a benefit that she appreciated particularly.

In many ways Ms TP4 is the epitome of a “best ager”, i.e. someone who has a healthy active lifestyle, enjoys close relationships with family and friends and has a positive outlook on life. Besides, she continues learning new skills such as a new language, is interested in new developments (such as ALADIN) and is engaged in helping others. She is comfortably off, regularly goes on vacation with friends and has a clear idea about the things that make life worth living. Therefore she has no need for assistance, at least for the time being. However, if in the future she became physically impaired, she might well consider using assistive technologies to compensate for any impairments.
Test Person 5

**Personal Profile:** TP5 is male and 67 years old and lives in his own house near Dietramszell, which belongs to the administrative district of Bad Tölz. His immediate family includes two sons with their wife/girlfriend and two grandchildren. He lives alone on his farm since his wife died three years ago. One of his sons lives in an attached building together with his girlfriend. TP5 used to work in the fields of communications and magnetic fields engineering in a company and is still working as a farmer. He used to have cows but now he only has farming. He is very interested in other cultures and likes to go on journeys with a party. During the ALADIN field tests TP5 went on a journey to Greece for one week. He found a new girlfriend who lives in Bad Tölz and they visit each other but do not live together.

**Motivation for participating in the ALADIN field test:** Curiosity, interested in the technology used for ALADIN.

**The time with ALADIN:** Mr TP5 gets up early in the morning and starts the day with a good breakfast. During his breakfast he reads the newspaper and turns on the automatic light control. After breakfast he makes one relaxation and one activation exercise. After his start into the day he goes outside and works in his garden or on the fields. At noon he makes himself lunch and then does again two exercises (one for relaxation and one for activation). In the afternoon he goes outside again for farming or he takes a long walk in the nearer area. In the evening TP5 prepares his dinner and then conducts two exercises (one for relaxation and one for activation). His evening program usually consists of lighting the fire in the fireplace (when it's cold outside), which is located in the living room, and then he takes a good book and reads or watches TV. Sometimes he drives to his girlfriend to Bad Tölz and spends the night there.

In Mr TP5's opinion especially the relaxation exercises could be more precise. He reported that he felt nervous but the system showed that he was relaxed or that he e.g. began with a high pulse rate and this decreased but still showed that he was not really able to relax. He especially had problems with the muscle exercise. The naming of „muscle exercise” seemed to irritate him. In total TP5 found the ALADIN prototype interesting but really worth for revision, especially concerning the relaxation exercises.

TP5 is a very systematic and accurate man who always seeks for doing his best. The ALADIN system worked quite well in his home and he did not have any problems with the glove. In the beginning there was a little problem with the lighting system because the electricians had to exchange one lamp and then this light seemed to live a life of its own. After reprogramming the whole system everything worked properly. As we asked him whether he would buy himself a similar system like the prototype he abnegated.

Test Person 6

**Personal Profile:** TP6 is female and 64 years old and lives alone in a small rented apartment in Bad Tölz. Although she is not yet 65 years old yet, we included her into the field-tests because of her intense interest in the study. She has been married but now is divorced. She has a daughter and three grandchildren who all live in the region of the black forest. TP6 used to work as a buying agent. She lived in Schleswig-Holstein but then moved to Bad Tölz because of several health-related problems (e.g. macular degeneration, arthritis, high blood pressure etc.). Bad Tölz is a health resort and so she wanted to help herself by moving to such a region. She is highly engaged in the work with elderly people in the seniors advisory board and organises coffee parties. She is also an active member of the church choir and sings a lot at funerals and she is a member of the local parish too. TP6 especially likes to solve cross word and sudoku puzzles.

**Motivation for participating in the ALADIN field-tests:** Curiosity, very interested in the impact of light on mood and quality of life.

**The time with ALADIN:** TP6 gets up early in the morning and starts into the day with two exercises (one for relaxation and one for activation). Sometimes she combines the relaxation exercise with quigong, which works fine for her. After her breakfast she goes to sing at a funeral
together with the church choir. After the funeral TP6 goes back home and reads a newspaper, solves cross word puzzles, and prepares lunch. After lunch she does two exercises with ALADIN prototype. In the afternoon she goes to events of the seniors advisory board and prepares coffee parties or has a choir practise. When she comes home she starts the adaptive lighting control of the ALADIN prototype and watches TV or reads the newspaper. After this time, she prepares dinner and eats. After dinner she does her last two exercises of the day and ceases the day with watching TV or reading.

TP6 enjoyed participating in the field-tests and especially liked the warm light for relaxation. She did not like the bluish light for activation too much because she perceived the light to be cold. After the deinstallation of the lighting system she felt that she missed the ALADIN lights because they generated a much brighter light in the room. She especially enjoyed the mental exercises and relaxation exercises, whereas she had the same problem like TP5. She thought that the nomination „muscle exercise” was kind of irritating to her.

Although there have been some problems in the beginning with the programming of the lighting system, TP6 was very patient. She had a lot of fun in doing the activation exercises because she likes to do riddles and puzzles. Concerning the relaxation exercises, she had the experience that she felt rather nervous but the computer told her that she was relaxed. She was glad to participate in the field test, although she would not buy a system like this in the existing version. Nevertheless she seemed to be interested in new technologies and assisting devices for elderly people.

Test Person 7

**Personal Profile:** Ms TP7 is 78 years old and lives in her own large two and a half room penthouse flat in the centre of Bolzano with a large roof terrace directed to the south. She lives there since she was retired and shares her living with a small blind dog and two budgies in a cage in the living-dining room.

She worked as a secretary in another town for almost all her life and has never married nor had children. That's why her social network is rather limited. Moreover she is a very erudite person and expects a certain level when socializing. For that reason she feared her friends could misunderstand her interest in participating at the field test and make a mock of her. She often complains about the silliness of people and politicians and is a very conscious and critical person.

Ms TP7 is absolutely independent and does not suffer from any impairments except for an arthrosis in a hip which impedes her going for longer walks. Other casual discomforts are headache and fatigue. Her flat is well accessible by a lift and she does not plan to give it up even though the big uncovered terrace with lots of plants and flowers requires much work. During the time she is living there she has adapted everything to her needs and liking and does not want to do big changes.

Basically her attitude towards technology is positive but when she is confronted with technical devices she behaves rather shy and gets nervous pretty easily. Try and error is very far away from her way to get to know a strange machine. On the other side she handles a TV set, a satellite receiver, and a video recorder without any problems except that she does not programme the latter and that the whole set was installed by a technician.

**Motivation for participating in the field tests:** For some coincidence Ms TP7 read about the ALADIN project in a local newspaper and at the same time heard from a friend that she might participate as a test person. After a preliminary discussion in which she proved to be an open-minded and curious, but also very critical person she agreed to take part, still doubting the sense of the whole thing. However she expected at least to broaden her mind and get to know new people.

**The time with ALADIN:** A two-seated couch in the living-dining room with a small table giving good view to the TV set was chosen for the implementation. After the installation of the TV computer combination Ms TP7 needed some days to get used to her new home entertainment system. The first annoyance was that the TV did not correctly switch to the 16:9 format so the displayed image was sometimes distorted. A manual change with the internal TV menu would have been possible but Ms TP7 was already overstrained using the new remote control, finding
the right TV channels, and changing between satellite and terrestrial TV. It took her about a week
to habituate to the whole system and to start with the exercises.

After this „acclimatisation” Ms TP7 used her ALADIN system quite regularly. Before ALADIN
she interrupted her daily tasks to sit down, repose, and read a while. Now she used ALADIN for
these short breaks and developed a certain ambition to obtain good scores in the activation
exercises. However the relaxation activities did not work that well because the sensor glove
would not initialise.

The frequent visits by the assistants lead to strong social side effects. After a workaround was
found to get the glove going (salt and water) the assistance became less, and Ms TP7 exercised
ambitiously. She found out how she could improve or even manipulate the scores by answering
very fast or by doing knee bends before relaxation, and she complained that no advice was given
to her because of her good results.

Ms TP7 had quite high expectations when the light component was installed because till now she
was rather disappointed of the frequent malfunctions and the easiness to outsmart the system. As
the lighting devices could not be programmed on the first intent and the light-supported exercises
would not work in the beginning, it took almost another week to get the complete ALADIN
system to work correctly.

Ms TP7 continued with the exercises as before which was the function she liked most even if she
had never thought she might play computer games one day. Nevertheless at the end she was quite
happy when the whole system was deinstalled and she got back her beloved CTR TV set without
display distortions and a better sound. Apart from the exercises which awakened her ambition,
what she enjoyed most of the whole field test was the regular contact with the assistants, and she
did what she could to extend these moments by invitations to have a meal together etc.

Ms TP7 enjoyed the time with ALADIN quite a lot. The frequent exercises structured her day,
awakened her ambition to train her mental fitness and sometimes even amused her. But most of
all she liked to be visited by the assistants and to have so many occasions for inspiring
conversations. However she criticised the frequent malfunctions and the limited feedback and she
laughed at the avatar which she found rather ridiculous. After the handling troubles in the
beginning she felt somehow superior to the „stupid machine” in the end. One of the handling
problems had to do with the rubberised keys of the remote control. Ms TP7 missed a clear trigger
point. The lighting component seemed to her awfully powerful and she was impressed by the
bright light. Due to the orientation of the windows towards south and summertime though she
preferred a dimmed down preset for watching TV in the evening. When using automatic light
adaptation or light-supported exercises she hardly perceived positive effects and she doubted any
correlation between the exercises, her current status and the light changes. Ms TP7 concluded that
the system as it is is not by far ready to go into production.

Ms TP7 showed off some difficulties when it came to collect survey data. She took the field tests
very seriously and was keen about the correctness of the answers she gave. She criticised the
standardised survey instruments because in many occasions she did not see her answer reflected
in the pre-defined options. So she kept a meticulous diary. When doing the mental fitness tests
Ms TP7 felt quite under pressure and she improved from time to time mostly because she got
used to the procedure and lost her nervousness.

All in all Ms TP7 was a very typical senior test person with a marked anxiety towards
technology. Her higher age, the limited social surrounding, and the beginning impairments
concerning mobility made her somewhat a member of the key target group. It was very
interesting to observe how the daily exercises gave more structure to her everyday life. But the
most significant and surprising result was her joy doing the exercises in spite of her reservation
against modern technical devices. The ALADIN prototype awakened her ambition to improve her
mental fitness in a way the normal daily tasks would not. Nevertheless big part of the positive
effects derived from the frequent and intensive assistance – that is: personal care.

Test Person 8

Personal profile: Ms TP8 is 69 years old, widowed and lives in Bolzano in her own three room
flat with a small kitchenette in the dining room. The small balcony and all the windows are
directed to the north so the flat is rather dusky. Ms TP8 worked as a tour guide and travelled around a lot. Still now she organises journeys with elderly people as a volunteer for a clerical welfare organisation where she is actively engaged. Moreover she takes care of her old mother who lives in an own flat nearby. Ms TP8 has a very open-minded, cheerful, and spontaneous personality. Ms TP8 has no reservation against modern technology. She uses a cellular phone and a laptop. The latter serves her for writing letters and emails, booking flights and hotels, or doing internet research on holiday destinations. As her internet access is on demand and not a flat rate she had some troubles with updating her anti virus scanner but in general she is almost an expert user.

**Motivation for participation:** Ms TP8 became a participant in the field tests because of her engagement in a welfare organisation which was contacted to recruit test persons. She was curious about the project because the purchase of the laptop had risen her interest in modern computer technology. When one gets to know Ms TP8 some closer it is not a surprise that after the preliminary discussions she decided she should not miss the opportunity to try out something really fancy as it would be an intelligent „wonderlamp”.

**The time with ALADIN:** As Ms TP8 worried a bit about the traces that could be left on the walls of her living room she opted for the dining room as an adequate place for the implementation of the system. Here she usually occupies a corner seat with a small television nearby. With her spontaneous try and error method she soon got used to the TV computer combination even though she had to use two remote controls, one for switching between analogue and digital TV and the other to navigate the ALADIN menu. Later on the assistants found out that one remote control would have been sufficient, but everything was left as ist was.

Ms TP8 had not only done relaxation exercises before she had also worked as an instructor, and she got perfect results right from the start. She really enjoyed watching her pulse coming down when trying out her repertoire of suggestive techniques. On the other hand she did not like the activating exercises that much, maybe also because she is rather a comfortable person. As her usual TV set was quite small it was replaced by the smaller one of the two available monitor sizes. This made some of the exercises, especially the letter rows, more demanding. Ms TP8 solved this problem herself and put an armchair close to the ALADIN installation. From then on even the activating exercises did not cause any problems.

Some malfunctions derived from the two remote controls because Ms TP8 used them simultaneously and pressed the keys rather impatiently. But she also understood that there was a normal computer more or less like hers behind the whole installation and paid attention to avoid handling errors. Maybe if one had given her the keyboard and the mouse she would have had a try to manage the thing herself.

The frequent problems with the sensor gloves could be resolved by applying a little bit of salty water.

The light installation failed at the first intent due to problems when programming the luminaires. It took almost a week to have it going. Later the conventional switch box did not work, so Ms TP8 had to switch off the light via the ALADIN menu which required pressing some keys at least five times. However she managed all these difficulties with humour and in a second intent one of the working presets was changed into the off status.

As the balcony door of the dining room is directed towards north Ms TP8 had never experienced such a bright light in this room as it was possible now. So she used the manual light control also during daylight. On the other hand she did not like the automatic light. Some strange flickering effects could be resolved with an ALADIN update but also later she complained that the light would not fit at all.

Ms TP8 very soon found out how to obtain always perfect results with the exercises and got a little bored. Sometimes she interrupted the use of the system for a few days and had to be motivated to carry on again. Because of logistical problems in the beginning, the late delivery of the components and the programming trouble with the light devices there was a delay which collided in the end with Ms TP8’s scheduled travels. The second AL2 phase had therefore to be interrupted at an early state. The testing was done after that and refers thus to both AL phases.
Ms TP8 did not need much personal assistance. Most of the handling problems and malfunctions could be resolved by phone calls. As she was almost always busy with other things to do, the ALADIN field test never became the most important part of her everyday life. She did the exercises with great routine and missed a more detailed and demanding feedback, but most of the time she did the activities with ALADIN as an afterthought. She did not perceive the ALADIN prototype as an integrated system but as a bunch of independent functions with different qualities. In her eyes the automatic lighting did not work, the manual light was impressive by sheer power but also excessive, and the exercises were nice but rather limited and nothing new having in mind the functionality of her laptop. During the whole field test Ms TP8 remained rather unperturbed and turned back to her normal TV set and lamps as if nothing had happened.

Collecting survey data with Ms TP8 was very easy because she did not take it too serious and gave quick and precise answers. The tests of mental fitness worked well but Ms TP8 did not make an effort to obtain the best results.

In general Ms TP8 did not let herself involve too much in the field test which was at times even an advantage because in that way the ALADIN prototype could be tested under „normal” everyday conditions and not as an extraordinary period in life. It could be observed very clearly how limited functions or malfunctions lead to a loss of interest when there are alternatives to do. And it was also interesting to see how a friendly design and motivating feedback awake ambition. In the end Ms TP8 proved not to be a member of the target group. She was always busy with things which kept her going and she did not seem „retired” at all. The ALADIN system was neither able nor necessary to structure her everyday routine and she was a very selective user switching it on for one of her preferred relaxing exercises or just to adjust the light. A dimmer and some interesting computer games on her laptop would have served her as well but due to the lack of time she does not even think about it.

Test Person 9

Personal Profile: TP9 is female and 83 years old and lives in her own flat in Bad Tölz, a town in Bavaria. She has grown up in Berlin and abscended without her family to Stuttgart during the Second World War. After the war she studied German and English in Munich. In the last years before her retirement she worked as a director of a secondary school in Bad Tölz. She was involved with Terres des Hommes and adopted two children from North Korea. She has never been married or engaged and managed her job and family independently. She lives in her own flat for many years now. Her immediate family includes her two grown-up daughters and their children who are living in towns nearby Bad Tölz. TP9 is very active and involved with several organisations for the elderly although she has serious heart problems. She is doing some fitness exercises every day.

Motivation for participating in the ALADIN field-tests: Curiosity.

The time with ALADIN: TP9 is an early riser. She gets up at 6.00 to 6:30 and after breakfast she performs a relaxation exercise and another exercise for activation. She is very ambitious, but never content with activating her mind. She regularly does some fitness exercises to stay fit. After breakfast she goes shopping and prepares lunch. Once a week she spends some time with one of her daughters. She spends a lot of time in reading. Reading is her passion. She switches on the automatic lighting of the ALADIN prototype to assist her with reading the newspaper or the latest novel. Before going to bed, she is also reading for at least one and a half hours.

Overall, TP9 could not enjoy participating in the field test. The lighting installations did not work properly, the sensor glove was not comfortable and was much too large. One of the lamps was smelling burnt and another one could not be repaired at all. She even collapsed during the field phase. She was really happy to get the system out of her flat at the end of the field test.

Because there have been many problems during the hole project phase, she was very nervous and ALADIN was a load. She was rather quickly bored by the missing diversification in the exercises presented by the ALADIN system. The relaxation exercises were very useful for finding out that she had a much to low heart rate, which could be corrected. TP9 is still interested in new technologies and assisting devices for elderly people.
Test Person 10

**Personal Profile:** TP10 is female and 72 years old and lives in a flat for rent at the outskirts of Bad Tölz, a Bavarian town. She has grown up in Berlin and moved to Bad Tölz when her son was 3 years old. She worked in the last years before her retirement as a nurse in a hospital in Bad Tölz. She managed her job and family independently as a single mother and was married for a few years just some years ago. Her immediate family includes her grown-up son who is living in Bad Tölz. Her son, a personal fitness trainer takes care of her physical fitness status. TP10 is an active woman. She does some fitness exercises every day although she is a strong smoker. TP10 is interested in philosophical themes, painting is her passion.

**Motivation for participating in the ALADIN field-tests:** Curiosity and money.

**The time with ALADIN:** TP10 is an early riser. She gets up at 6.00 after breakfast she performs a relaxation exercise and another exercise for activation. She is ambitious and regularly does some fitness exercises to stay fit. After breakfast she is reading or painting. She spends a lot of time with her son and his friends. In the afternoon she does some fitness exercises or goes for a walk. She spends a lot of time in painting. She switches on the automatic lighting of the ALADIN prototype to assist her with reading or painting. Before going to bed, she watches TV or reads. Overall, TP10 enjoyed participating in the field test. The lighting installations worked properly most of the time, and the sensor glove was comfortable. However TP10 did not like the activating light, it was too bright.

During the whole project phase TP10 was always expecting more, she was rather quickly bored by the missing diversification in the exercises presented by the ALADIN system. She is still interested in new technologies and assisting devices for elderly people and would take part as a test person in other AAL-projects.

Test Person 11

**Personal Profile:** TP11 is female and 66 years old and lives in Bad Tölz near the train station in a big flat all by herself. She has been living in Bad Tölz now for more than 30 years. Her both sons live nearby and she takes their children every Tuesday and Thursday afternoon to watch for them. She used to work as a social worker until she turned 64. Now she is engaged in work with underprivileged teenagers who need support in school and finding an apprenticeship. She is a very active woman. She likes to go riding her bicycle together with friends and has a wide social network.

**Motivation for participating in the ALADIN field-tests:** Curiosity and interest in new developments. Her personal interest was to do something for the following generations.

**The time with ALADIN:** TP11 gets up early in the morning and starts into the day with two exercises (one for relaxation and one for activation). After doing her exercises she makes herself breakfast or invites someone for breakfast. Then she cleans up her flat and goes shopping. In the following she prepares lunch for her and her three grandchildren, whom she picks up at kindergarten and school. Before getting her grandchildren she does some exercises for relaxation and activation. Then she has lunch together with her grandchildren and plays with them. In the late afternoon she brings the grandchildren back and drives home. There she starts the automatic light adaptation and uses it for about one hour. During the light adaptation she either watches TV or reads a book. After the automatic lighting she conducts her last two exercises for the day (one for relaxation and one for activation) and then prepares dinner. After dinner she watches TV or reads a book and goes to bed.

TP11 did not like the light installations too much. She thought they look kind of futuristic and were to obvious in the room. For the mental exercises she liked especially the one with the black and white discs. But after a while she found the selection of exercises a bit boring. For the relaxation exercises she said it was a bit difficult because she has heart problems (irregular heart beats) which was probably difficult for the system to learn.

With the automatic lighting she had a lot of problems. Her living room is very big and the distance between ALADIN and the glove was about five meters. So she could not really move...
because otherwise the system lost the signal and the automatic lighting stopped. She newly started the system several times but mostly it stopped after half an hour. So therefore she thought the system did not really work for her. She also said that she would not buy a system like this in the current version of the prototype but said that if the lighting could be build into the walls it would not be so obvious anymore and would be more indirect. She said that the times for relaxation helped her to calm down and she is still trying to keep up with this even after the system is gone.

Although there have been some problems with the handling of the glove together with the automatic lighting, Mr TP11 was very patient. Concerning the relaxation exercises, she had the experience that she felt rather nervous but the computer told her that she was relaxed. After the testing period she was happy to have the system out of her house because she felt kind of restricted in her living through the lighting system and all the tasks she had to do with it. Nevertheless she seemed to be interested in new technologies and assisting devices for elderly people.

**Test Person 12**

**Personal Profile:** TP12 is female and 66 years old and lives in Bad Tölz in a flat all by herself. She has lived in Bad Tölz from until 1995 and then moved to the northern part of Germany. After only one year there her husband died of a heart attack. After another two years she sold the house and came back to Bad Tölz because she felt at home here. Her son and her daughter live far away but visit her sometimes. She is a very active woman. She likes to go biking and swimming together with her friends. Sports also help her with her fibromyalgia which she is suffering from. She has some problems with her heart (irregular heart beats) and therefore takes some medication against it.

**Motivation for participating in the ALADIN field-tests:** Curiosity and interest in the impact of lighting on mood, money.

**The time with ALADIN:** TP12 likes to sleep late in the morning and gets up at about eight or nine o'clock. After getting up she prepares herself a breakfast and then conducts two exercises (one for relaxation and one for activation). Then she cleans up her flat, goes shopping and watches TV. Following she prepares lunch. After lunch she does two exercises and goes for a ride on her bike or swimming for about two hours. When she comes home she watches TV again or meets a friend. Then she starts the automatic light adaptation and uses it for about one hour. During the light adaptation she either watches TV or reads a book. After the automatic lighting she conducts her last two exercises for the day (one for relaxation and one for activation) and then prepares dinner. After dinner she watches TV or reads a book and goes to bed.

TP12 did not like the light installation too much. She thought they look like lamps for surgery. For the mental exercises she liked especially the one with the black and white discs. This exercise speeded up her ambition. For the relaxation exercises she said it was a bit difficult because she has heart problems (irregular heart beats) which was probably difficult for the system to learn. Therefore she always had to lay down for doing the exercises because her heart beat would not change too much in this position. She did not have problems with the automatic lighting. Only once there were two lights that did not work but these lights were exchanged and everything worked well then. She felt kind of restricted to the certain times she had to do the exercises and the automatic lighting. TP12 did not have the impression that lighting improved her mood or made her feel better with her fibromyalgia.

TP12 was very conscientious in the tasks that were to do during the testing. She always tried to adhere to the three times for exercises and automatic lighting. Whenever she noticed something different, she called and reported about it. In the end she was happy to have the system away because she felt quite restricted by it.
Annex B. Field Test Manual

1 Introduction


2 Study objective

Arbeitshypothesen

1. Welchen allgemeinen Einfluss hat der ALADIN-Prototyp (Advice-System in Kombination mit einem adaptivem Lichtsystem) auf Personen im Alter ab 65 Jahren?
   1.1 Durch den ALADIN-Prototypen wird das subjektive Wohlbefinden erhöht.
   1.2 Durch den ALADIN-Prototypen wird die subjektive empfundene Lebensqualität erhöht.

2. Welche Unterschiede bestehen zwischen den einzelnen Versuchsbedingungen „nur Advice-System“ (AS), „Algorithmus 1“ (AL 1) und „Algorithmus 2“ (AL 2)?
   2.1 Im Vergleich zur Versuchsbedingung (AS), treten bei den Bedingung AL1 und AL2 die positivsten Veränderungen hinsichtlich mentaler und physischer Fitness, subjektivem Wohlbefinden und subjektiver Lebensqualität auf.
   2.2 Den größten Einfluss bezüglich der Kriterien
      - mentale Fitness
      - physische Fitness
      - Schlafqualität
      - subjektives Wohlbefinden
      - subjektive Lebensqualität
   werden die Bedingungen AL 1 und AL 2 haben, einen geringen Einfluss wird die Situation AS aufweisen und die Bedingung ohne Installation wird den geringsten Einfluss ausüben.
3. Wie werden durch den ALADIN-Prototypen die körperliche und geistige Konstitution verändert?

3.1 Durch den ALADIN-Prototypen wird die mentale Fitness verbessert.
3.2 Durch den ALADIN-Prototypen wird die physische Fitness verbessert.
3.3 Durch den ALADIN-Prototypen wird die Schlafqualität verbessert.

3 Study design

Die Fragestellung der vorliegenden quasi-experimentellen Untersuchung wurde mittels einer vierfach gestuften unabhängigen Variable umgesetzt. Die unabhängige Variable stellt hier die Art der Installation dar.

<table>
<thead>
<tr>
<th>Art der Installation</th>
<th>1. Keine Installation</th>
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<tbody>
<tr>
<td></td>
<td>2. nur Advice System (AS)</td>
</tr>
<tr>
<td></td>
<td>3. Algorithmus 1 (AL 1)</td>
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<tr>
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<td>4. Algorithmus 2 (AL 2)</td>
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</tbody>
</table>

Die Wirkung der unabhängigen Variable wird in einem within-subject-Design untersucht, d.h. jede Versuchsperson erlebt alle Arten der Installation. Die Reihenfolge der Installationsarten wird bezüglich Bedingung AL 1 und AL 2 permutiert, wobei die Bedingung „keine Installation“ nicht permutiert wird, sondern auf zwei kürzere Phasen von einer Dauer von 1,5 Wochen aufgeteilt wird, um eine Baseline-Testung am Beginn und eine End-Testung ohne System zu gewährleisten. Zusätzlich dienen diese beiden installationsfreien Zeiten dazu, das System zu installieren bzw. zu deinstallieren.


Zwischen der Kondition „Advice System“ und der darauf folgenden Licht-Kondition sollten zwei Testfreie Tage eingeplant werden, weil in dieser Zeit die Lichtinstallation in den Räumlichkeiten der Testperson eingebaut wird. Die Testzeiten finden also von Januar bis März, März bis Mai und Mai bis Juli statt.

Zeitplan für die Testungen

Wie im Abschnitt 3.1 dargestellt, werden die Testungen in drei Zeiträumen ablaufen und pro Testzeitraum werden vier Versuchspersonen getestet werden, wobei sich die Zeiträume wie in 3.1 beschrieben überlappen.

Der genaue Zeitplan für die Testungen im ersten Quartal ist wie folgt:
Tabelle 1: Zeitplan der Testungen im ersten Quartal

<table>
<thead>
<tr>
<th>VP Nr.</th>
<th>Bedeutung</th>
<th>Dauer</th>
<th>Januar 2008</th>
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<th>März</th>
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<td>KW 1</td>
<td>KW 2</td>
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Tabelle 2: Zeitplan der Testungen im zweiten Quartal

Zeitpunkt für Tests für Wohlbefinden, Lebensqualität, Schlafqualität, mentale & physische Fitness

Der Zeitplan für das dritte Quartal wird so aussehen:

**Tabelle 3: Zeitplan der Testungen im dritten Quartal**

<table>
<thead>
<tr>
<th>VP Nr.</th>
<th>Bedingung</th>
<th>Mai 2008</th>
<th>Juni 2008</th>
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<tbody>
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<td>AL 1</td>
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<td>Baseline</td>
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<tr>
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<td>End test</td>
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</tr>
</tbody>
</table>

▼ = Zeitpunkt für Tests für Wohlbefinden, Lebensqualität, Schlafqualität, mentale & physische Fitness

Die Versuchspersonen 9 bis 12 werden vom LMU-MUENCHEN in der Region Bad Tölz und Lenggries getestet.

**4 Subjects**

**Einschlusskriterien für die Auswahl**

Im Rahmen des Projektes wurde sich auf folgende Einschlusskriterien für Testpersonen geeignet:

- Mindestalter von 65 Jahren
- Alleinlebende Personen
- Offen gegenüber der Bedienung technischer Entwicklungen
- Nutzung neuer Technologien ohne Angst
- Technische Affinität
- Für die Betreuer und Institute gut zu erreichen
- Gewillt für ca. vier Stunden pro Tag einen Brustgurt zur Ableitung psychophysiologischer Daten zu tragen
- Gewillt psychologische Tests auszufüllen
- Gewillt sich anfangs täglich und später mehrmals wöchentlich persönlich oder telefonisch betreuen zu lassen
- Gewillt bauliche Maßnahmen zum Zwecke des Einbaus der Lichtsysteme vornehmen zu lassen (Wiederherstellung des Ursprungszustandes wird garantiert)
- Mindestmaß an Mobilität, d.h. noch in der Lage, selbstständig einzukaufen und kürzere Strecken zu reisen

Ausschlusskriterien für die Auswahl
Im Rahmen des Projektes wurde sich auf folgende Ausschlusskriterien für Testpersonen geeignet:

1. In Verbindung mit der Ableitung psychophysiologischer Signale:
   - Ernsthafte kardiovaskuläre Erkrankungen (extremer Hypertonus und Hypotonus, Herzschrittmacher)
   - Ernsthafte neurologische oder psychiatrische Erkrankungen (affektive Störungen, (photosensitive) Epilepsie, schwere Demenz)
   - Schwerwiegende hormonelle Erkrankungen
   - Fortgeschrittene Diabetes

2. In Verbindung mit Sehstörungen:
   - Schwerer Grad des Katarakts (erlaubt sind Anfangsphase und schon operierter Katarakt)
   - Glaukom (und andere schwerwiegende Sehstörungen)

3. Andere relevante Probleme und Bedingungen:
   - Schwerwiegende Erkrankungen (z.B. in Behandlung befindliches Karzinom)
   - Viel Zeit im Freien verbringen und häufiger Solariumbesuch

Anzahl der Testpersonen
Ursprünglich war es vorgesehen, insgesamt 24 Testpersonen in einem between-subject-design zu untersuchen. Da hierfür jedoch sehr ähnliche Testpaare für die Experimental- und Kontrollgruppe nötig gewesen wären (gleicher medizinischer Status, gleiches Alter, ähnliche Wohngegend, gleiches Geschlecht...), haben sich die Projektpartner auf ein within-subject-design geeinigt.

Um die Kosten für die Installation von Lichtsystem und Advice-System einzusparen, wurde die Anzahl der Testpersonen auf 12 Personen beschränkt, die von Januar bis Juli 2008 getestet werden.

Versicherung der Testpersonen
Für die Versuchspersonen muss in jedem Fall eine Unfall-Wege-Versicherung abgeschlossen werden. Dadurch werden Unfälle versichert, die auf dem Weg zum Institut und zurück nach Hause passieren könnten. Zusätzlich könnte auch eine Versicherung günstig sein, die verschuldensunabhängige Risiken abdeckt.

Checklisten für die Auswahl der Testpersonen
Die erste der beiden Checklisten beinhaltet Fragen über die Lebensbedingungen der Personen und wird in deren Wohnung durchgeführt werden. Dies macht es für den Interviewer möglich, einen detaillierten Blick auf das Appartment zu haben und Bilder zu machen.


**Tagebücher der Testpersonen**

Die Testpersonen erhalten ein Leitz-Büchlein mit hartem Einband. In dieses Tagebuch können die Testpersonen positive und negative unbeabsichtigte Wirkungen aufschreiben. Diese Maßnahme gibt zum einen den Testpersonen die Möglichkeit, alles zu dokumentieren, das ihnen auffällt (positiv wie negativ) und zum anderen wird hierdurch verhindert, dass wichtige Informationen für die Auswertung vergessen werden.

**5 Coaching of subjects**

**Anzahl der Betreuer**


Jedes Institut ist für die Suche und Schulung von Betreuern selbst verantwortlich. Um jedoch ein ähnliches Qualitätsniveau der Betreuer zu garantieren, werden im folgenden Ein- und Ausschlusskriterien definiert.

**Einschlusskriterien**

Folgende Kriterien sollten unbedingt bei den Betreuern vorhanden sein:

- Hohes soziales Engagement
- Vertrauenswürdigkeit
- Hohes Maß an Empathie
- Verschwiegenheit
- Räumliche Nähe zu den zu betreuenden Personen und dem jeweiligen Institut
- Mobilität, d.h. Führerschein Klasse B und eigener PKW für die Anfahrten bzw. gute Anbindung ans öffentliche Verkehrsnetz
- Tägliche Verfügbarkeit während der Testphase
- Technikaffinität
- Sicher im Umgang mit neuer Technik

Bei der Auswahl der Betreuer sollten die genannten Kriterien in jedem Fall erfüllt sein.

**Ausschlusskriterien**

Als Ausschlusskriterien gelten die folgenden:
Potenzieller Missbrauch von Informationen, die die Betreuer von den Testpersonen oder Instituten erhalten

Geplanter Urlaub während der Testphase

Versicherung der Betreuer
Für die freiwilligen Betreuer der Testpersonen wird ebenfalls eine Unfall-Wege-Versicherung abgeschlossen. Somit sind die Betreuer für alle Unfälle versichert, die auf dem Weg zur Testperson oder dem Institut und auf dem Weg nach Hause passieren könnten.

Informationsbroschüre für Betreuer
Die Informationsbroschüre beinhaltet allgemeine Informationen zum Projekt (Teilnehmende Institutionen, Ziele der Studie und Komponenten des Prototyps) sowie Informationen über den Umfang der Betreuung während der Testphasen und über wichtige Eigenschaften, die potentielle Betreuer aufweisen sollten.

Schulung der Betreuer
Die Schulung der Betreuer findet durch die Ansprechpartner am jeweiligen Institut statt. Die Schulung der Ansprechpartner vor Ort ist eine wichtige Voraussetzung um die Betreuer gut einarbeiten zu können. Empfehlenswert ist daher, wenn mindestens ein Ansprechpartner besser aber je zwei Ansprechpartner pro Institut die bereits testenden Partner BLL und FHV besuchen, um einen persönlichen Eindruck zu gewinnen. Durch die persönliche Anwesenheit während wichtiger Testphasen (Systemstart, Übergang zwischen zwei Konditionen etc.) kann ein wesentlich besserer Eindruck gewonnen werden als abstrakt während einer Schulung.

Im Anschluss werden die so geschulten Ansprechpartner der Institute ihr Wissen im Schulungshandbuch für Betreuer wiedergeben. Dieses Schulungshandbuch für Betreuer und eine Schulung, die von den Ansprechpartner jeweils in ihrer zu betreuenden Region durchgeführt wird, bieten eine sehr gute Voraussetzung für die Betreuung der Testpersonen.

Inhalte der Schulung

Für eine reibungslose Handhabung des technischen Systems werden alle durchzuführenden Handlungen praktisch erklärt und von den Betreuer selbst nochmals eingeübt.

Zusätzlich wird mindestens je ein Ansprechpartner pro Institut für die Betreuer zur Seite stehen.

Aufbau der Schulung
Der genaue Aufbau der Schulung ist derzeit noch nicht ausgearbeitet und wird wohl erst im Zuge der ersten Testungen im Dezember stattfinden. Da der Zeitplan für die technische Erstellung des Systems sehr eng gesteckt ist, wird der technische Teil der Schulung direkt vor Ort stattfinden.

Der psychosoziale Teil der Schulung kann von den jeweiligen Instituten schon vor der technischen Schulung stattfinden. Die Ausarbeitung der psychosozialen Schulung wird gesondert nachgereicht.

Zeitplan der Schulungen für jedes Institut
Für die erste Schulung der Betreuer im November sollte die psychosoziale Schulung bereits zwei Wochen vor Beginn stattfinden. Die technische Schulung wird direkt vor Ort bei den
Probanden stattfinden. So lernt der Betreuer zum einen die Testperson kennen und kann zum anderen gleich vor Ort ausprobieren, wie die Geräte funktionieren. Die technische Einweisung in die Geräte sollte am ersten Tag der zweiten Testbedingung, d.h. nach der Baseline Testung, stattfinden.

Ansprechpartner der Betreuer für jedes Institut
Diese Ansprechpartner stehen für die Betreuer in jedem Institut, das an den Testungen teilnimmt, zur Verfügung.

BLLr:
Siegfried Mayr
Bartenbach Licht-Labor
Rinnerstr. 14
A – 6701 Aldrans
Siegfried.mayr@bartenbach.com

FHV:
Philipp von Hellberg
Fachhochschule Vorarlberg
User Centered Technologies Research
Hochschulstr. 1
A – 6850 Dornbirn
pvh@fhv.at

APOLLIS:
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LMU-MUENCHEN:
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Astrid Plankensteiner
LMU-MUENCHEN - Generation Research Program
Humanwissenschaftliches Zentrum
Ludwig-Maximilians-Universität München
6 Execution of study

Ethische und behördliche Überlegungen

Ethikkommission
Jede Institution ist für den Antrag bei der zuständigen Ethikkommission selbst zuständig. Eine Vorlage erhalten die Institute vom Generation Research Program der LMU München bis Mitte Oktober.

Informed Consent

Technische Instruktionen für die verwendeten Geräte

Advice System (FHV)
Die technischen Anleitungen für Hardware, Bedienung der Software, Administration der Software und die Konfigurationsdateien können im Anhang 9.5 gefunden werden. Änderungen der Fachhochschule Vorarlberg werden eigenständig vorgenommen und den Partnern mitgeteilt.

Lichtsystem (BLL)

Allgemeine Hinweise

Versicherung der Geräte
Für die Versicherung der Geräte ist folgendes zu beachten. Jeder Partner übernimmt die Verantwortung/Haftung für die selbst hergestellten Produkte und die entsprechende Versicherung. Geräte, wie Computer, Leuchten, Fernseher u.s.w., die von anderen Firmen gekauft werden, fallen unter die Herstellerversicherung.

Ansprechpartner für technische Geräte und Software
Ansprechpartner in technischen Belangen für die verwendeten Geräte und die verwendete Software sind die folgenden:

BLL
Siegfried Mayr, Ansprechpartner für Lichtsystem
Bartenbach Licht-Labor
Rinnerstr. 14
A – 6701 Aldrans
Siegfried.mayr@bartenbach.com

FHV:
Karl-Heinz Emich, Ansprechpartner für Advice-System
Fachhochschule Vorarlberg
User Centered Technologies Research
Hochschulstraße 1
A – 6850 Dornbirn

UPB:
7 Testing of effects

Beabsichtigte Wirkungen des Systems

Überprüfung des Wohlbefindens
Zur Überprüfung des subjektiven Wohlbefindens wird der WHO-5-Well-being Index verwendet. Er umfasst insgesamt 5 Fragen zum subjektiven Befinden, die auf einer Likert-Skala von 5 (die meiste Zeit) bis 0 (zu keinem Zeitpunkt) beantwortet werden. Daraus ergibt sich ein Rohwert zwischen 25 und 0. Ein Rohwert von 25 indiziert ein sehr gutes Wohlbefinden, wohingegen ein Rohwert von 13 und niedriger in Richtung auf eine Depression schließt und zusätzlich eine Abklärung auf Depression mittels beispielsweise des Becks-Depressions-Inventars (BDI) stattfinden sollte.

Dieser Test, WHO-5 Wellbeing Index, wurde aufgrund seiner Kürze ausgewählt. Somit werden die VPn nicht unnötig lange befragt.

Überprüfung der Lebensqualität

Überprüfung der Veränderung der mentalen Fitness
Durch das Advice-System, das Bestandteil des ALADIN-Systems sein wird, werden zum einen kognitive Leistungen über kurze Übungen trainiert und zum anderen die Fähigkeit zur Entspannung über Biofeedbacktraining eingeübt.


Folgende Tests werden verwendet:
- Number Verification-Test (wird von BME zur Verfügung gestellt)
- Zahlenverbindungstest (ZVT) (aus NAI)
- Bildertest (aus NAI)

Überprüfung der Veränderung der physischen Fitness
Die physische Fitness ist nicht direkter Bestandteil des Systems, wie die mentale Fitness. Dennoch werden über Wohlfühltipps, Hinweise auf körperliche Betätigung zur Verbesserung der physischen Fitness gegeben.
Zu Überprüfung, ob Veränderungen in der physischen Fitness aufgetreten sind, wird folgender Test durchgeführt:

Groningen Fitness Test for the Elderly (Singh, Paw, Bosscher & van Mechelen, 2006)

Dieser Test wird vor und nach jeder Testphase zum Einsatz kommen, um die körperliche Leistungsfähigkeit zu überprüfen.

Überprüfung der Veränderung der Schlafqualität
Da Licht einen sehr wichtigen Einfluss auf den Lebensrhythmus des Menschen hat, ist davon auszugehen, dass auch in diesem Bereich Veränderungen auftreten werden.
Bei Lichteinstrahlung wird die Produktion von Melatonin unterdrückt und setzt erst wieder zwei bis drei Stunden vor der Schlafenszeit ein. Mit zunehmendem Alter werden die Ausschüttungen des Melatonins während Dunkelphasen aus der Zirbeldrüse immer geringer, wodurch ein durchgegehender Schlaf erschwert wird.
Zudem wird ein guter Schlaf auch durch ein ausgewogenes Verhältnis von Anspannung und Entspannung während des Tages gefördert. Bei älteren Personen jedoch kommt es häufig vor, dass sie sich aufgrund körperlicher Einschränkungen oder Erkrankungen nicht mehr genug bewegen und somit die Anspannung im Lebensrhythmus zu kurz kommt.

Eine Veränderung der Schlafqualität wird über den Pittsburgh Sleep Quality Index erfragt.
Zusätzlich werden Fragen zum subjektiven Empfinden der Schlafqualität angefügt.

Testung der Akzeptanz und Gebrauchstauglichkeit des Systems
Auch der Umgang mit dem System spielt bei den Versuchen eine entscheidende Rolle. Die Sicherheit im Umgang wird dabei zum einen durch die Gebrauchstauglichkeit (= Usability) und zum anderen durch die Akzeptanz der Technik bestimmt. Zusätzlich nimmt natürlich auch die Attraktivität bzw. das Aussehen der Nutzeroberfläche einen wichtigen Platz ein. Ist die Oberfläche nicht ansprechend gestaltet, wird hierdurch auch die Bedienung beeinträchtigt.

Folgende Tests sind hierfür vorgesehen:

Usability-Fragebogen (von FHV)
AttrakDiff (auch von FHV)
Akzeptanz-FB (von apollis)

Diese Tests sind ausschließlich nach Beendigung der Feldphase zu erheben, d.h. also zum letzten Erhebungszeitpunkt.

Unbeabsichtigte Wirkungen des Systems
Bisher sind unbeabsichtigte Wirkungen von Licht und Lichtsystemen nur im Bereich des höheren Frequenzspektrums und bei höheren Intensitätsgraden festgestellt worden. Das ALADIN-System arbeitet in einem Spektral- und Intensitätsbereich (normale Raumbeleuchtung), der keine unbeabsichtigten Wirkungen erwarten lässt. Auch beim Advice-

8 Ablauf der Experimente

Aufbau der Geräte und Baseline-Testung
Die Geräte werden 1,5 Wochen vor Beginn der Testung komplett aufgebaut und installiert (Phase „B“ Baseline). Für die jeweiligen Bedingungen „AS“, „AL 1“ und „AL 2“ werden die jeweiligen Funktion für den Testzeitraum der jeweiligen Kondition deaktiviert.

Zeitplan für Aufbau
Der Aufbau sollte nicht mehr als 3 Tage in Anspruch nehmen, um die Versuchspersonen nicht unnötig zu belästigen. Der Beginn der Installationsmaßnahmen ist der zweite Tag der Testungen. Am ersten Tag der Testungen werden die Fragebögen und Tests erhoben. Fällt der zweite Tag der Testungen auf einen Sonntag, so sind die Installationsmaßnahmen für das System auf den folgenden Montag zu verlegen. Sonntags werden generell keine Installationen vorgenommen.

Zeitplan für Baseline-Testung
Die Baseline-Testung beinhaltet folgende Fragebögen:

- WHO-5 Wellbeing Index
- Kurzform SEL (Skalen zur Erfassung der Lebensqualität)
- Pittsburgh Sleep Quality Index (PSQI)
- Number-Verification-Test
- Zahlenverbundungstest (ZVT)
- Bildertest
- Fitness-Test


Um zu beurteilen, ob es in den Bereichen der mentalen und physischen Fitness Verbesserungen gegeben hat, werden zu Beginn und am Ende dieser Testphase Tests zur Überprüfung des Wohlbefindens und der Lebensqualität, der Schlafqualität und der mentalen und physischen Fitness durchgeführt. Da das Ende einer Testung gleichzeitig den Anfang einer neuen Testbedingung bedeutet, werden die Tests daher zu insgesamt 6 Zeitpunkten stattfinden, die bereits in den Tabellen 1 bis 3 unter Abschnitt 3.2 eingetragen sind. Diese sind:

- Erster Tag der Testung
- Letzter Tag der Baseline-Testung (= erste Testung der nächsten Bedingung)
- Letzter Tag der nächsten Bedingung (= erster Tag der nächsten Bedingung)
- Letzter Tag der nächsten Bedingung (= erster Tag der nächsten Bedingung)
- Letzter Tag der nächsten Bedingung (= erster Tag der Endtestung)
- Letzter Tag der Endtestung
Zeitplan für die Betreuung der Versuchspersonen


Testung Aladin-Prototyp (komplettes System)

Anbringung der Elektroden


Die Elektroden werden immer vor den Biofeedback-Übungen angelegt und sie werden dann angebracht, wenn das Lichtsystem als Unterstützung bei diversen Aktivitäten benötigt wird.

Starten des Systems


Durch Auswahl der Übungen kann der Nutzer im nächsten Schritt entscheiden, ob er Biofeedback/Entspannungs-Übungen oder mentales Training durchführen möchte. Durch Auswahl der entsprechenden Option, werden die jeweiligen Übungen gestartet.

Durch Auswahl des Buttons Rückschau erhalten die VPn einen Rückblick auf die letzten 5 Tage und wie gut in diesen Tagen ihre Fähigkeit war, sich zu aktivieren oder zu entspannen.

In der Option Wohlfühl tipps wird dem Nutzer nochmals das Ergebnis der 5-Tage-Rückschau rückgemeldet und es werden drei verschiedene Wohlfühl tipps angeboten, die in der Erreichung von Entspannung oder Aktivierung behilflich sein sollen.

Wählt die Testperson die Option Fernsehen, so geht das TV-Gerät automatisch an.

Durchführung der Übungen


Es sollten pro Trag mindestens zwei Übungen zur Entspannung und zwei Übungen zur Aktivierung durchgeführt werden. Es sollte darauf geachtet werden, dass die VPn immer zuerst die Übungen zur Aktivierung durchführen, dann den Handschuh anlegen und anschließend die Biofeedback-Übungen durchführen.

Die Messzeit für eine Übung zur Aktivierung beträgt ca. 5 min, im Anschluss sollte direkt eine Entspannungsübung (Biofeedback) mit einer Dauer von ca. 10 min erfolgen.
Übungen und Tests


Eine weitere Übung wird so gestaltet sein, dass die VPn ein Wort präsentiert bekommen und zusätzlich eine ungeordnete Reihe von Buchstaben. Die Person soll hierbei so schnell und so korrekt wie möglich entscheiden, ob alle Buchstaben des präsentierten Wortes in der ungeordneten Buchstabenreihenfolge vorkommen.

Der dritte Test wird mit Bildern sein.


Folgenden Tests werden dabei erhoben:

- WHO-5 Wellbeing Index
- Kurzform SEL (Skalen zur Erfassung der Lebensqualität)
- Pittsburgh Sleep Quality Index (PSQI)
- Number-Verification-Test
- Zahlenverbindungstest (ZVT)
- Bildertest
- Fitnessstest

Zusätzlich werden vor Beginn der Testungen und am Ende der dreimonatigen Testzeit die IADL’s (instrumental activities of daily living) erhoben. Dies erlaubt eine Feststellung darüber, ob die VPn sich auch in ihrer allgemeinen Leistungsfähigkeit verbessern konnten.

Testung Advice-System

Das Advice-System beinhaltet das komplette Übungspaket inklusive Wohlfühltipps. Gemessen werden die jeweiligen psychophysiologischen Zustände der Versuchsperson während den Entspannungsaufgaben (Biofeedback) und die Ergebnisse in den mentalen Aktivierungsaufgaben.

Anbringung der Elektroden

Vor der Durchführung der Entspannungsaufgabe muss der Sensorhandschuh angelegt werden. Die Anlegung des Brustgurtes ist für die mentalen Aktivierungsaufgaben nicht erforderlich.

Starten des Systems

Das Advice System wird gestartet, indem die VPn zunächst den Fernseher anschalten. Anschließend können sie über den Button Übungen zu den Entspannungs- und Aktivierungsaufgaben starten. Über den Button Rückschau erhalten die VPn eine 5-Tage-Auskunft über ihre Fähigkeiten, sich aktivieren oder entspannen zu können. Wählen sie die
Schaltfläche Wohlfühltipps, so wird zunächst nochmals die Zusammenfassung des Rückblicks erscheinen und anschließend drei Wohlfühltipps gegeben, die sie in einer besseren Erreichung des Zielzustandes (Entspannung, Aktivierung) unterstützen sollen.

**Durchführung der Übungen**

Die Übungen müssen täglich mindestens zweimal und an jedem Tag der Woche durchgeführt werden. Die Reihenfolge ist von der Testperson selbst festzulegen. Vor der Entspannungsübung muss stets ein Handschuh durchgeführt werden.

**Tests**

Um zu beurteilen, ob es in den Bereichen der mentalen und physischen Fitness Verbesserungen gegeben hat, werden am Ende dieser Testphase Tests zur Überprüfung des Wohlbefindens und der Lebensqualität, der Schlafqualität und der mentalen und physischen Fitness durchgeführt. Da das Ende einer Testung gleichzeitig den Anfang einer neuen Testbedingung bedeutet, werden die Tests daher zu insgesamt 6 Zeitpunkten stattfinden. Diese sind:

- Erster Tag der Testung
- Letzter Tag der Baseline-Testung (= erste Testung der nächsten Bedingung)
- Letzter Tag der nächsten Bedingung (= erster Tag der nächsten Bedingung)
- Letzter Tag der nächsten Bedingung (= erster Tag der nächsten Bedingung)
- Letzter Tag der nächsten Bedingung (= erster Tag der Endtestung)
- Letzter Tag der Endtestung


Folgenden Tests werden dabei erhoben:

- WHO-5 Wellbeing Index
- Kurzform SEL (Skalen zur Erfassung der Lebensqualität)
- Pittsburgh Sleep Quality Index (PSQI)
- Number-Verification-Test
- Zahlenerbildungstest (ZVT)
- Bildertest
- Fitnesstest

**Testung Advice-System**

Das Advice-Systembeinhaltet alle Anwendungen bis auf das adaptive Lichtsystem. Die herkömmlichen, bisher in der Wohnung befindlichen Lichtverhältnisse werden nicht verändert.

**Anbringung der Elektroden**


**Starten des Systems**

Um das System zu starten, wird der Fernseher angestellt. Die Optionen Rückschau, Übungen und Wohlfühltipps sind aktiviert.

**Tests**

Um zu beurteilen, ob es Verbesserungen gegeben hat, werden am Ende dieser Testphase Tests zur Überprüfung des Wohlbefindens und der Lebensqualität, der Schlafqualität und der mentalen und physischen Fitness durchgeführt. Bei der Durchführung der Tests ist zu beachten, dass zuerst die Tests zur Überprüfung der mentalen Fitness, dann die Tests zum Wohlbefinden, zur Lebensqualität und Schlafqualität und am Schluss die Tests zur Überprüfung der physischen

Folgende Tests werden dabei erhoben:
- WHO-5 Wellbeing Index
- Kurzform SEL (Skalen zur Erfassung der Lebensqualität)
- Pittsburgh Sleep Quality Index (PSQI)
- Number-Verification-Test
- Zahlenverbindungstest (ZVT)
- Bildertest
- Fitnesstest

**Abbau der Geräte und Endtestung**

*Zeitplan für Abbau*

*Zeitplan für Endtestung*

Folgenden Tests werden dabei erhoben:
- WHO-5 Wellbeing Index
- Kurzform SEL (Skalen zur Erfassung der Lebensqualität)
- Pittsburgh Sleep Quality Index (PSQI)
- Number-Verification-Test
- Zahlenverbindungstest
- Bildertest
- Fitnesstest
- AttrakDiff
- Usability-Fragebogen
- Akzeptanz-Fragebogen

*Zeitplan für die Betreuung der Versuchspersonen*

9 Datenauswertung

Stichprobengröße
Die Stichprobengröße umfasst in dieser Untersuchung 12 Versuchspersonen.

Evaluation der Effektivität

Primäre Variablen der Effektivität
Als primäre Variablen der Effektivität werden sowohl die Fragebogendaten als auch die physiologischen Parameter für Entspannung, die aus GSR, HR, HRV und Bewegungssensoren abzuleiten sind, verwendet.

Sekundäre Variablen der Effektivität
Sekundäre Variablen der Effektivität in dieser Untersuchung sind die Einschätzungen der Betreuer und der Verwandten der VPs über den Zustand der jeweiligen Testperson.

Analysemethoden
Als Analysemethoden werden SPSS (Version 15), SAS, Windows EXCEL sowie weitere Datenverarbeitungsprogramme verwendet.

Geplante Zwischenanalysen
Es sind keine Zwischenanalysen geplant.

Zuständigkeit für Auswertung der Tests
Aufgrund der langjährigen Erfahrung in der Auswertung von Daten ist Apollis für die Auswertung der erhobenen Fragebogendaten zuständig.
Aufgrund der langjährigen Erfahrung in der Auswertung von psychophysiologischen Daten ist die Fachhochschule Dornbirn für die Auswertung der psychophysiologischen Daten (GSR, HR, HRV und Bewegungssensorik) verantwortlich.

Checkliste zur Auswahl der potentiellen Testpersonen

Teil I: Zuhause bei den Personen

Datum: _______ Uhrzeit:_______
Name:_________ Alter:_______
Geschlecht: w___ m___
Erlernter Beruf/ ehemaliger Beruf:_______

Interviewer:_______
1. Wie zufrieden sind Sie mit Ihrer derzeitigen Wohnsituation?
   __sehr zufrieden
   __eher zufrieden
   __weniger zufrieden
   __überhaupt nicht zufrieden

2. Wie viel Quadratmeter hat Ihr Wohnzimmer?
   ___m²

Interviewer macht Fotos vom Wohnzimmer (in alle vier Himmelsrichtungen)
→ Wichtig: es sollte erkenntlich werden, wo sich Fenster und Türen, die Leuchten und die Sitzmöglichkeiten befinden

Interviewer sollte für das Wohnzimmer überprüfen, ob:
   a) das Wohnzimmer eine weiße Decke hat
   b) Temperaturprobleme (im Sommer) existieren (abfragen bei Person)

3. In welchem Raum halten Sie sich tagsüber am längsten auf?
   Wohnzimmer
   Küche
   Arbeitszimmer

Wie lange halten Sie sich in diesem Zimmer auf? ___h ___min.

4. Wo in diesem Raum befinden Sie sich am meisten (z.B. am Tisch, auf der Couch...)?
   ____________________________________________________________
   ____________________________________________________________

5. Welche Aufgaben erledigen Sie wo tagsüber im Wohnzimmer? Geben Sie maximal 3 Haupttätigkeiten, geordnet nach ihrer zeitlichen Länge, an!
   Tätigkeit und Dauer ihrer Dauer Ort im Wohnzimmer
   a. _____________________________________________________________
   b. _____________________________________________________________
   c. _____________________________________________________________

→ Einschätzung des Interviewers

6. Anzahl in diesem Zimmer erfassen:
   großes Fenster __
   kleines Fenster __
   Balkontür __
   (Ess-)Tisch __
   Stühle (insgesamt) __
   Bequeme Sessel __
   Sofa mit Sitzplatz __
   Schreibtisch __
   Computer __
   Fernseher __
   Deckenleuchten __
7. Welche Lampe schalten Sie im Wohnzimmer ein, wenn Sie zu wenig Tageslicht haben?

<table>
<thead>
<tr>
<th>Lampe</th>
<th>1 seltener</th>
<th>2 meistens/immer</th>
</tr>
</thead>
<tbody>
<tr>
<td>Deckenleuchte</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Wandleuchte</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Stehlampe</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tischlampe</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Schreibtischlampe</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

→ Einschätzung des Interviewers

8. Wohnungsrundgang: Lichtverhältnisse einschätzen (hell vs. dunkel) und evtl. Foto machen, alle Räume erfassen
   a. Lichtverhältnisse einschätzen
      __ sehr hell
      __ eher hell
      __ eher dunkel
      __ sehr dunkel
   b. Alle Räume erfassen:
      __ Wohnküche
      __ Küche
      __ Wohnzimmer/Stube
      __ Esszimmer
      __ Arbeitszimmer
      __ Schlafzimmer
      __ Bad
      __ WC separat
      __ Abstellraum
      __ Flur, Gang, Diele

9. Wenn Ihnen jemand vorschlagen würde, Ihre Lampen kostenlos gegen andere Lampen auszutauschen, wären Sie dazu bereit?
   __ ja
   Was würden Sie gegebenenfalls für neue Lampen ausgeben wollen?
   ______ €
   __ nein
   Und zu einem angemessenen Preis?
   __ ja
   __ nein
10. Und wenn man Ihre bisherigen Lampen dort lassen und nur zusätzlich Lampen
   einbauen würde, wäre Sie dann dazu bereit?
   __ja
   __nein

11. Wären Sie im Rahmen der Studie bereit, technische Geräte (z.B. Computer, neue
    Leuchten) für drei Monate daheim aufstellen bzw. einbauen zu lassen?
    Hinterher würde natürlich alles wieder kostenlos entfernt/rückgebaut werden.
    __ja
    __nein

12. Wären Sie im Rahmen der Studie bereit, an Gedächtnistrainings, die auf ihrem
    Fernseher gezeigt werden, teilzunehmen?
    __ja
    __nein

13. Wären Sie weiterhin im Rahmen dieser Studie bereit, täglich für maximal vier Stunden
    einen Brustgurt zu tragen, um Informationen für medizinische Analysen aufzuzeichnen?
    __ja
    __nein
Zum Abschluss noch eine allgemeine Frage:

14. Sind Sie im Ruhestand?
   _ja  _nein
Wie viele Stunden in der Woche arbeiten Sie? ____ Stunden
An wie vielen Tagen in der Woche arbeiten Sie? ______ Tage

Teil II: Testpersonen kommen zum Institut

Datum: _______     Uhrzeit:_________
Name:_________     Alter:______
Geschlecht:    w___    m___
Erlernter Beruf/ ehemaliger Beruf:_______

Interviewer:_______

1. Wie würden Sie Ihren Gesundheitszustand beschreiben?
   ___sehr gut
   ___gut
   ___mittelmäßig
   ___schlecht
   ___sehr schlecht

2. Leiden Sie derzeit unter einer der folgenden gesundheitlichen Beschwerden?

<table>
<thead>
<tr>
<th></th>
<th>Nein, keine</th>
<th>Ja, leichte</th>
<th>Ja, mittlere</th>
<th>Ja, große</th>
</tr>
</thead>
<tbody>
<tr>
<td>Schmerzen im Rücken, im Knie oder in einem anderen Gelenk</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Herzprobleme</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Atemnot, Atemschwierigkeiten</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Geschwollene Beine</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Durchblutungsstörungen</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Schwindel, Ohnmacht, kurzzeitige Bewusstlosigkeit</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Probleme mit Magen oder Darm</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Erschöpfungszustände, Energieverlust, starke Müdigkeit</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Kopfschmerzen, Migräne</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Konzentrationsschwäche</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
2.1 Sind Sie im letzten halben Jahr hingefallen?
  __ja   __nein  -> wenn nein, dann weiter bei 3

2.2 Beschreiben Sie den Sturz:

_____________________________________________________________________

2.3 Haben Sie Angst, hinzufallen?
  __nein
  __ja

4. Haben Sie andere Beschwerden?
  __ja, nämlich
  __nein

5. Haben Sie einen Herzschrittmacher?
  __ja
  __nein

6. Nehmen Sie zur Zeit Medikamente gegen eine der folgenden Erkrankungen ein?

<table>
<thead>
<tr>
<th></th>
<th>Ja</th>
<th>Nein</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hohe Cholesterinwerte</td>
<td></td>
<td></td>
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<tr>
<td>Mittel gegen hohen Blutdruck</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Medikamente wegen eines Herzinfarkts oder anderen Herzkrankheiten</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Gegen Asthma</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Gegen Diabetes</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Gegen Gelenkschmerzen oder Gelenkentzündungen</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Nehmen Sie andere Schmerzmittel, z.B. gegen Kopfschmerzen?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Medikamente gegen Schlafstörungen</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mittel gegen Angstzustände oder Depressionen</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
7. Wie heißen die Medikamente, Naturheilmittel und Nahrungsergänzungsmittel, die Sie derzeit einnehmen?
Wie müssen Sie diese Medikamente einnehmen?
z.B.: 1-0-0-0 (= morgens einmal, mittags, abends und nachts keine Einnahme)

<table>
<thead>
<tr>
<th>Medikament</th>
<th>Dosis &amp; Zeitpunkt der Einnahme</th>
<th>Grund der Einnahme</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
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</tbody>
</table>

8. Tragen Sie für gewöhnlich eine Brille oder Kontaktlinsen?
   __ständig
   __zeitweise: Wozu? ________________________________
   __nein

9. Tragen Sie normalerweise ein Hörgerät?
   __ja
   __nein

10. Gibt es jemanden, der Ihnen zu Hause hilft?
    __ja
    Wer? ________________________________
    Wobei? ________________________________
    __nein

11. Wer hilft Ihnen regelmäßig und hilft Ihnen noch jemand?
    __Sohn/Tochter
    __andere Familienangehörige
    __Freund/Freundin
    __eine Person der Caritas, des Arbeiter-Samariter-Bundes oder der Johanniter
    __eine bezahlte Hilfe
    __freiwillige Helferin einer Privatorganisation
    __sonstige Person, und zwar: ________________________________
12. Und wie oft kommt diese Hilfe zu Ihnen?
   _täglich
   _mehrmals pro Woche (z.B. 4-5 Mal pro Woche)
   _mehrmals pro Monat (z.B. 4-5 Mal pro Monat)

13. Wären Sie im Rahmen einer dreimonatigen Studie bereit, für maximal vier Stunden pro Tag, einen Brustgurt zu tragen, der Ihren Gesundheitszustand aufzeichnet?
   _ja
   _nein

14. Wären Sie im Rahmen der Studie bereit, sich anfangs fast täglich und nach einem Monat ca. ein- bis zweimal wöchentlich von einer Person betreuen zu lassen?
   _ja
   _nein

Informationsbroschüre für Betreuer

ALADIN – Ambient Lighting Assistance for an Ageing Population

Projektgruppe
Im Januar 2007 startete das EU-Projekt Aladin (ambient lighting assistance for an ageing population), ein interdisziplinäres Gemeinschaftsprojekt mit der Beteiligung von 7 europäischen Forschungsinstituten (Deutschland, Österreich, Italien, Ungarn, Rumänien) aus den Bereichen Psychologie, Medizin und Technik. Die Finanzierung des Projekts läuft über das sechste Rahmenprogramm der EU und ist für eine Gesamtdauer von 2 Jahren angelegt. Die Projektleitung des Gesamt-EU-Projekts liegt bei Herrn Prof. Guido Kempter und Frau Dr. Edith Maier von der Fachhochschule Vorarlberg, Dornbirn, Österreich.

Weitere Partner:
Bartenbach Licht-Labor, Innsbruck, Österreich;
Becker Meditech, Karlsruhe, Deutschland;
Apollis, Bozen, Italien;
Universität Budapest, Fachbereich für Ergonomie und Psychologie, Ungarn;
Universität Bukarest, Fachbereich für angewandte Elektro- und Informationstechnik, Rumänien.

Ziel und Konzept des Projekts
Ziel der Studie ist es, den Einfluss von Licht auf das Wohlbefinden und die Lebensqualität von älteren Menschen zu untersuchen.

Neuere Forschungen konnten Hinweise zeigen, dass mit der richtig gewählten Raumbeleuchtung nicht nur Gedächtnisleistung und allgemeine Aktivität in bestimmten Alltagssituationen angeregt, sondern auch das allgemeine Wohlbefinden gesteigert werden kann. Nicht nur die Wirkungen auf das visuelle System (gutes Sehen, bessere Wahrnehmung von Objekten, bessere Sturzvermeidung, bessere Orientierung) sondern auch die biologischen Wirkungen z. B. auf die innere Uhr oder den Einfluss auf Ein- und Durchschlafstörungen sollen untersucht werden.

Das adaptive Raumbeleuchtungssystem soll eine unterstützende Funktion für Entspannungsstadien, Gehirntraining und Motivation zur Bewegung bewirken. Idealerweise soll das System auch einen ausgewogenen Schlaf-Wach-Rhythmus (zirkadianer Rhythmus)
unterstützen, dadurch sind weitere positive Wirkungen auf die Lebensqualität und das Wohlbefinden zu erwarten. Ziel der Studie ist es daher, die Bedeutung von Licht auf das menschliche Wohlbefinden in verschiedenen Alltagssituationen zu evaluieren und ein adaptives Raumbeleuchtungssystem für die Generation Plus zu entwickeln. Für die Zielgruppe der Menschen ab 65 Jahren ist die Erhaltung einer eigenständigen Lebensweise für eine möglichst lange Zeit gewünscht und dies soll mit diesem neuartigen Lichtkonzept für Privathaushalte unterstützt und gefördert werden.


Eine Kombination aus Biosensoren erfasst die Parameter kontinuierlich und gibt in der Forschungsphase Rückschlüsse auf die Wirkung des Lichtsystems auf den Menschen. Das intelligente Lichtsystem als Endprodukt soll jedoch später ohne den Bewohner zu belästigen, in das Alltagsleben integrierbar sein. Intelligent bedeutet, dass die empfangenen psychophysiologischen Daten in das neuronale Netzwerk Eingang finden und dieses lernt, die Lichtverhältnisse an den gewünschten Zustand der Person anzupassen. Falls die Person es nicht ausreichend schafft, sich angemessen zu entspannen oder zu aktivieren, so erhält sie vom Advice-System Tipps für eine bessere Entspannung oder Aktivierung.


**Komponenten des Systems**


Das System wird nicht nur über die psychophysiologischen Parameter, wie Herzschlagfrequenz oder Hautleitwiderstand automatisch gesteuert werden, sondern auch eine manuelle Steuerung über eine graphische Benutzeroberfläche wird möglich sein, so dass die Personen selbst auch eine Möglichkeit haben, das Lichtsystem zu bedienen.

**Betreuer der Testpersonen**

Die Betreuer sollten sich darüber im Klaren sein, dass es für das Gelingen des Projekts unabdingbar ist, dass sie sich verpflichten, die gesamten 3 Monate während der Testung (April – Juni oder Juli – September) anwesend zu sein. Die freiwilligen Betreuer sollten genügend Zeit aufbringen können, um die zeitintensive Betreuung der VPn durchführen zu können. Weiterhin sollten Betreuer in jedem Fall sozial engagiert sein und über ein gewisses Maß an Empathie (Einfühlungsvermögen) für die älteren Testpersonen verfügen. Vertrauenswürdigkeit spielt in diesem Projekt zudem eine wichtige Rolle, da ethische Richtlinien befolgt werden müssen und sie von den VPn z.T. vertrauliche Informationen erhalten, mit denen verantwortungsbewusst umgegangen werden muss. Von Vorteil für die Betreuer wäre selbstverständlich das Interesse, an einer wissenschaftlichen Studie mitzuwirken.
Einverständniserklärung zur u.g. Studie und zur Datenverarbeitung und Aufbewahrung von Untersuchungsdaten

„ALADIN – Ambient Lighting Assistance for an Ageing Population“


Datenschutz:
Aus juristischen Gründen müssen wir auf folgendes hinweisen:
Es besteht kein Anrecht auf die anonymisierten Untersuchungsergebnisse, sowie auf einen finanziellen Ertrag, der sich aus den gewonnenen Ergebnissen eventuell ergibt.

Diese Einwilligungserklärung kann ohne Angabe von Gründen bis zur Anonymisierung widerrufen werden. Es entstehen daraus keine Nachteile für Sie. Die personenbezogenen Daten werden dann aus der Datei gelöscht. Nach Abschluss der Datenerhebung sind die Daten anonym, so dass naturgemäß dann keine Identifikation Ihrer Person möglich ist.

Für weitere Fragen steht der Projektleiter oder die aufklärende Person gerne zur Verfügung.

Ort/Datum: ___________ Unterschrift Studienteilnehmer: ____________________

Ort/Datum: ___________ Unterschrift des Projektleiters: ____________________
Verschwiegenheits- und Einverständniserklärung zur u.g. Studie

„ALADIN – Ambient lighting assistance for an ageing population“

Ich bestätige mit meiner Unterschrift, dass ich über Sinn und Tragweite der oben genannten Studie und der damit verbunden Teilnahme informiert worden bin. Art und Umfang der von mir auszuführenden Tätigkeit wurden ausführlich erörtert.


Ich bestätige mit meiner Unterschrift, kein Anrecht auf die Untersuchungsergebnisse sowie auf jeglichen finanziellen Ertrag geltend zu machen, sollte sich durch die Ergebnisse z. B. eine Vermarktung des Systems ergeben.

Ich habe den Inhalt des Informationsblattes, der Schulung und dieser Erklärung gelesen und verstanden und erkläre mich damit einverstanden, als freiwilliger Betreuer an der Studie mitzuwirken.


Für weitere Fragen stehen Ihnen der Projektleiter oder die Beauftragten des Studienleiters gerne zur Verfügung.

Ort/Datum: _______________ Unterschrift Betreuer: _______________________

Ort/Datum: _______________ Unterschrift des Projektleiters: _______________________

Final