



THE IMPACT AND BENEFITS OF INNOVATIVE, INTELLIGENT ASSISTIVE LIGHTENING FOR THE COGNITIVE DECLINE OF THE MCI INDEPENDENT SENIORS

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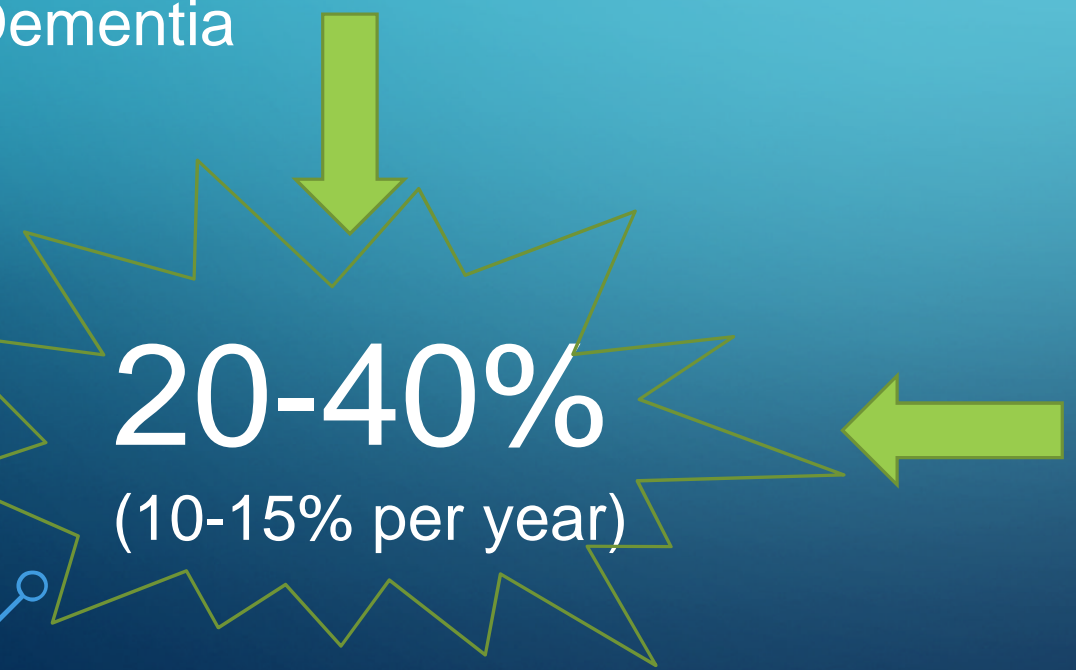
WHY

?

WHY MILD COGNITIVE IMPAIRMENT (MCI)?

MCI is an intermediate stage of cognitive deficit, which is often, but not always, a transitional stage between changes occurring during aging and dementia.

MCI Progression to
Dementia



20-40%
(10-15% per year)

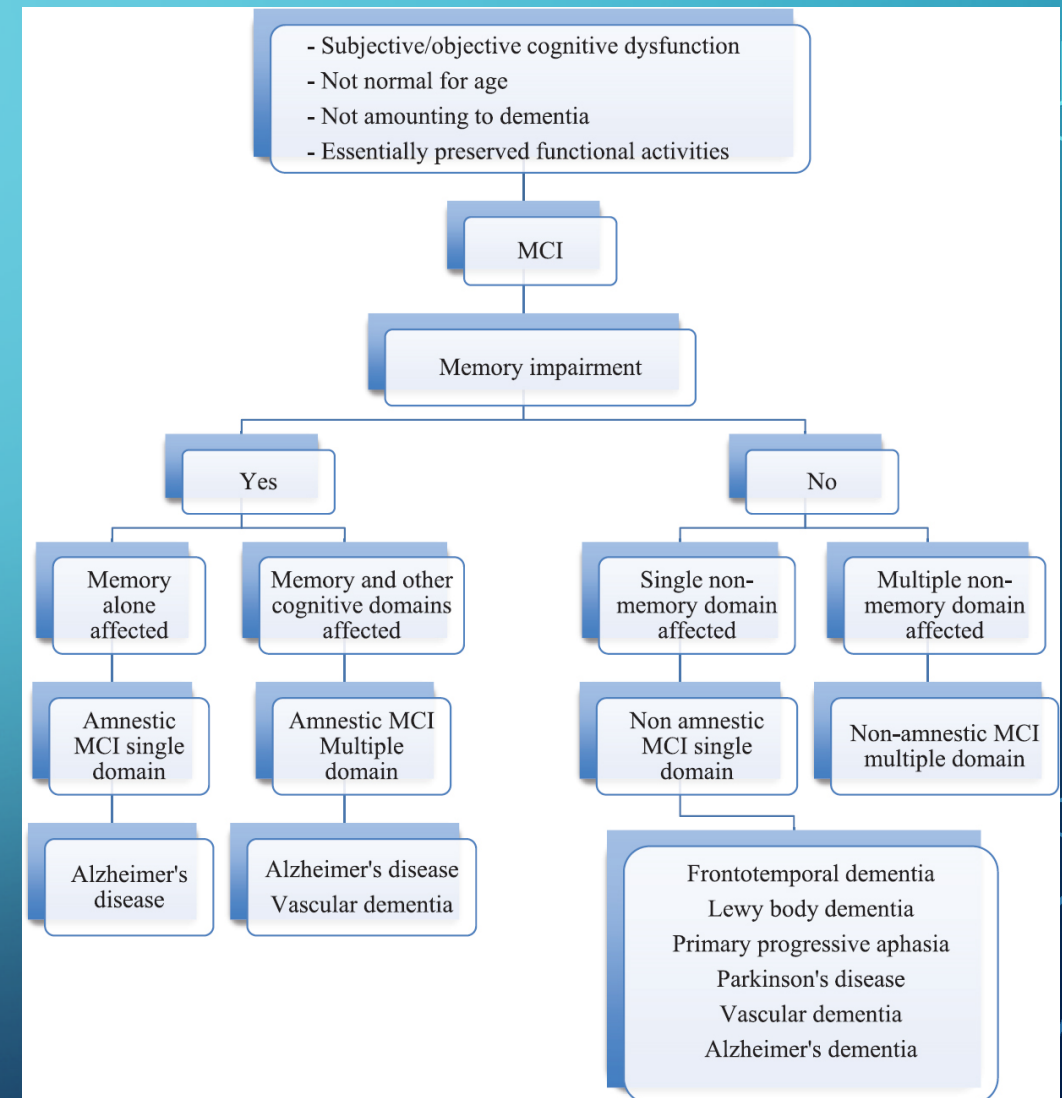
Risk Factors

- The degree of functional impairment
- Severity of neuropsychological test scores
- Presence of neuropsychiatric behaviours at the time of MCI diagnosis
- Abnormalities in structural magnetic resonance imaging (e.g. hippocampal atrophy, volumetric brain changes) and magnetic resonance spectroscopy of the brain

MCI ETIOLOGY AND CLASSIFICATION

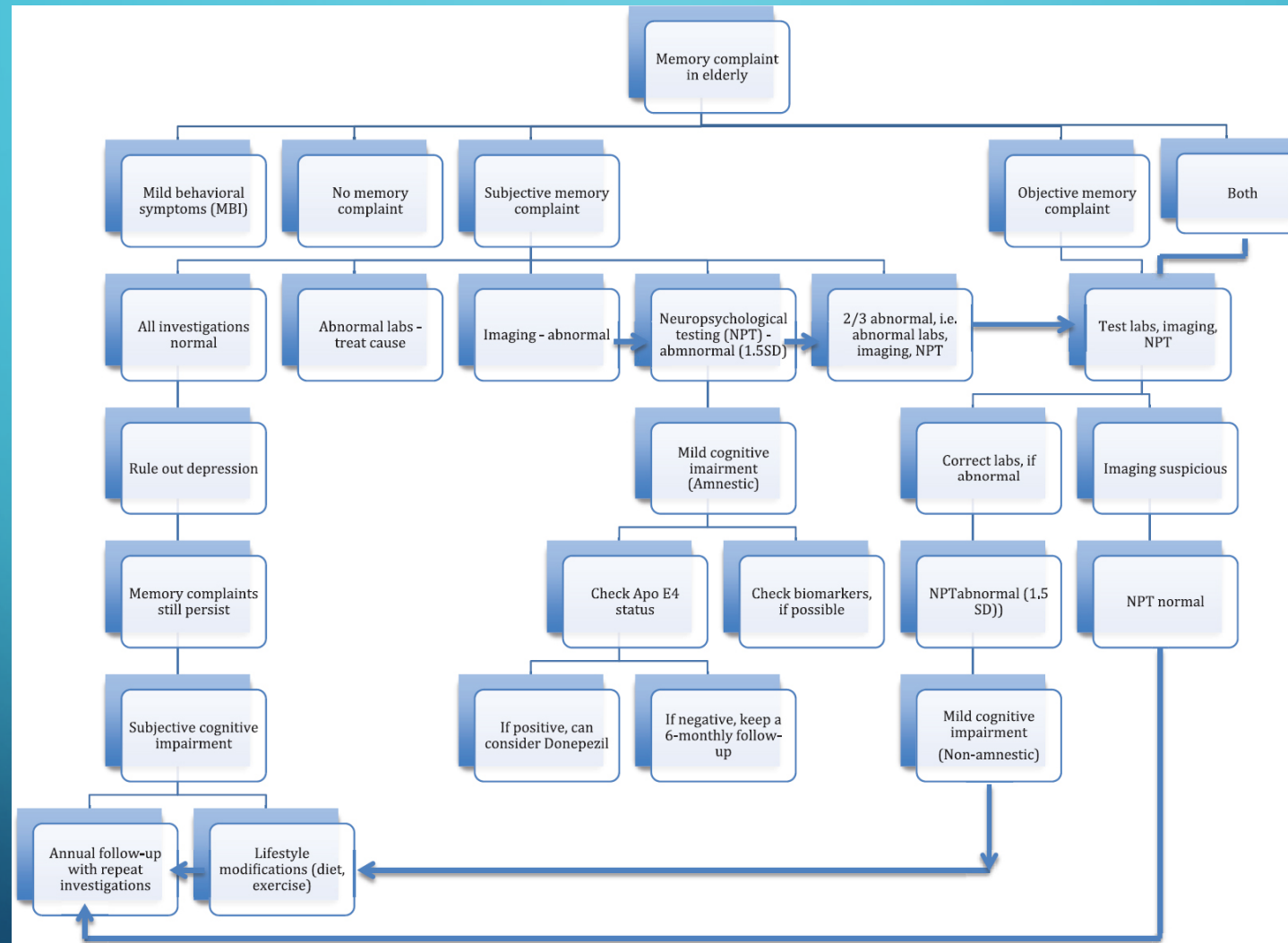
Considering impairment in the memory domain as well as in a single domain or multiple ones, MCI can be classified in 4 major subtypes – amnestic MCI (aMCI) and non amnestic MCI (naMCI), single or multiple domain as follows:

- **aMCI – single domain** (impairment only in memory),
- **aMCI – multiple domain** (impairment in memory and other cognitive domain),
- **naMCI – single domain** (impairment in a single cognitive domain, but not memory),
- **naMCI – multiple domain** (impairment in at least two cognitive domains, but not memory).



Subramanyam AA, Singh S. Mild cognitive decline: Concept, types, presentation, and management. J Geriatr Ment Health 2016;3:10-20

MCI DIAGNOSTIC APPROACH



Subramanyam AA, Singh S. Mild cognitive decline: Concept, types, presentation, and management. J Geriatr Ment Health 2016;3:10-20



HOW
?

The background is a teal-to-blue gradient. In the corners, there are white line-art illustrations of circuit traces and nodes, resembling a printed circuit board layout. These elements are positioned in the top-left, top-right, bottom-left, and bottom-right corners.

INNOVATIVE & INTELLIGENT ASSISTIVE LIGHTING

NON VISUAL LIGHT EFFECTS



Regulation of sleep-wake cycle
Regulation of appetite
Impact on mood
Impact on activity-rest-pattern
Impact on behaviour

Light exposure at the right time →
positive effects

Light exposure at the wrong time →
negative effects

NON VISUAL LIGHT EFFECTS

Short Term Effects

Physiological level

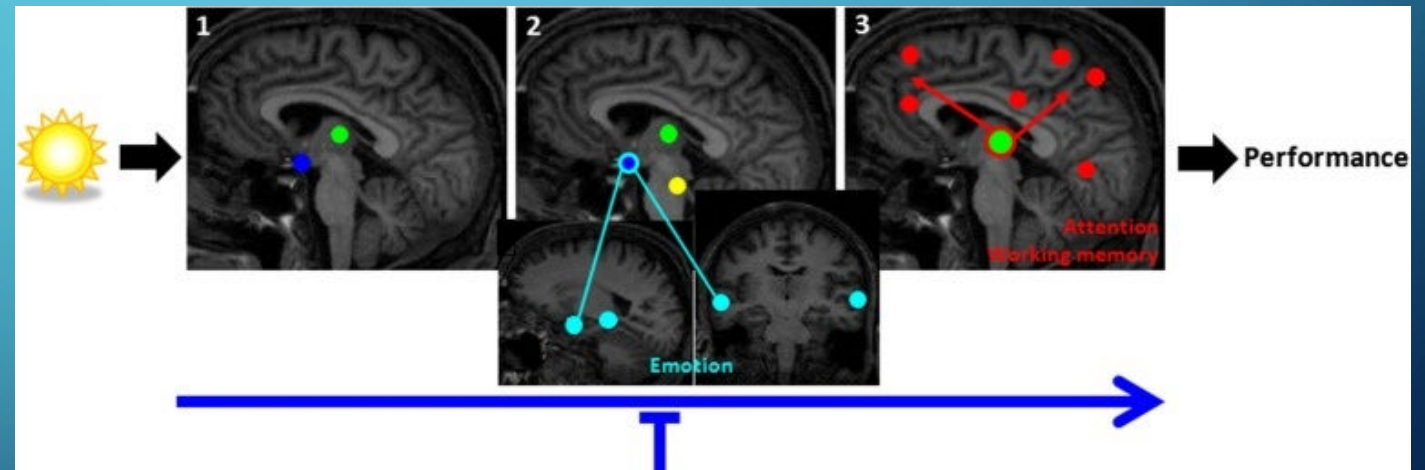
- Melatonin suppression
- Heart rate
- Cortical activity

Subjective level

- Wake state -> alertness/sleepiness

Cognitive Level

- Memory
- Attention



NON VISUAL LIGHT EFFECTS

Long Term Effects

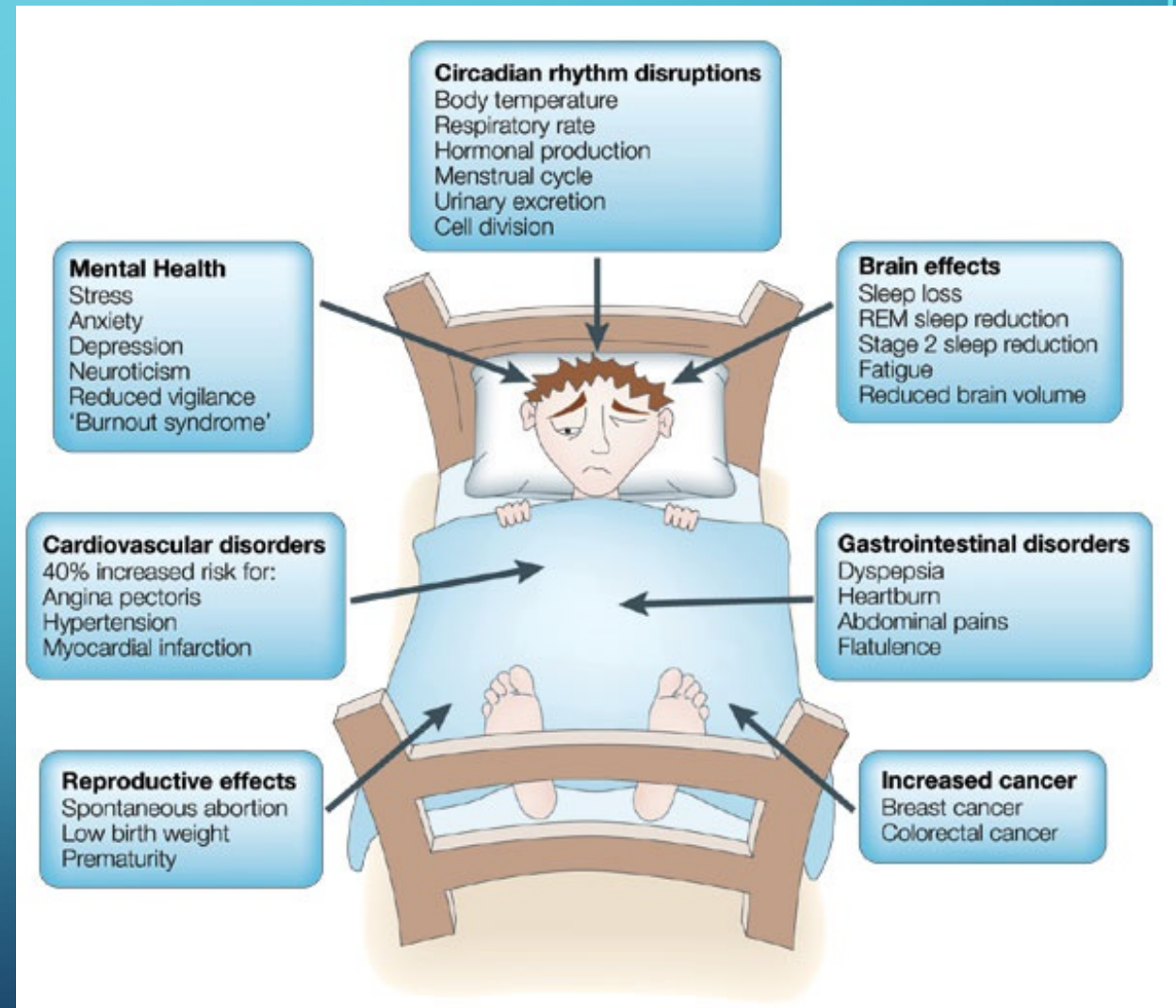
Chronodisruption (disturbing chronobiological rhythms)

International Agency for Research on Cancer



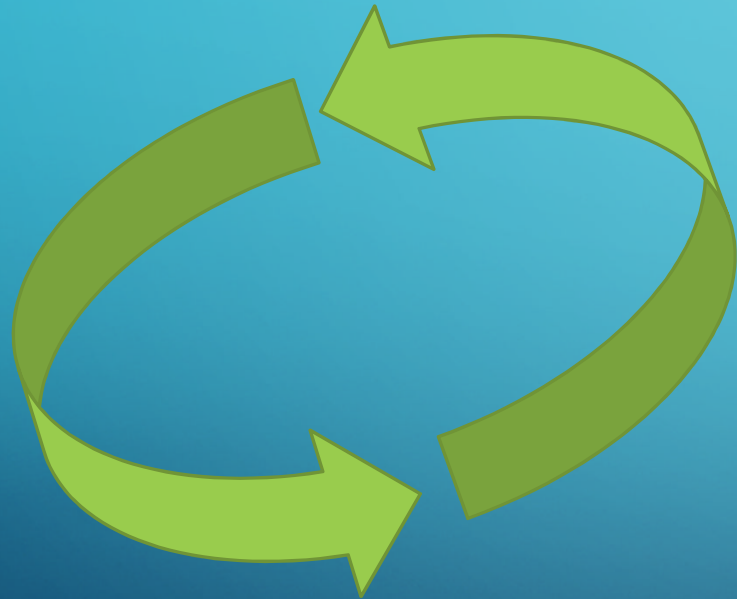
Group 1	<i>Carcinogenic to humans</i>
Group 2A	<i>Probably carcinogenic to humans</i>
Group 2B	<i>Possibly carcinogenic to humans</i>
Group 3	<i>Not classifiable as to its carcinogenicity to humans</i>
Group 4	<i>Probably not carcinogenic to humans</i>

Statement (published 2007)



PHOTOMETRIC FACTORS

(Triggers of the non-visual effects)

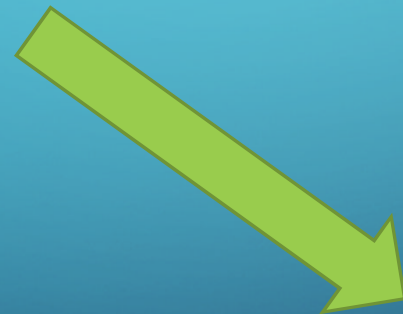


1. Light Intensity
2. Light Spectrum -
colour temperature
3. Time of exposure
4. Duration of
Exposure
5. Light History

ACTION & REACTION

Action

- We stay 90% of the time of the day in bad lit indoors
- We spend a lot of our night-time using lights and displays
- EU average (2010): 17,2% with night shift work with at least 1 shift/month



Reaction

- Weakness of Zeitgeber strength (A zeitgeber is any external or environmental cue that entrains or synchronizes an organism's biological rhythms to the Earth's 24-hour light/dark cycle and 12-month cycle)
- Chronodisruption



WHAT

?

PETAL

~PERSONALIZABLE ASSISTIVE AMBIENT
MONITORING AND LIGHTING~



AIM

Objectifying the effect of environment personalisation and lighting assistance on:

Spatial and Temporal Orientation

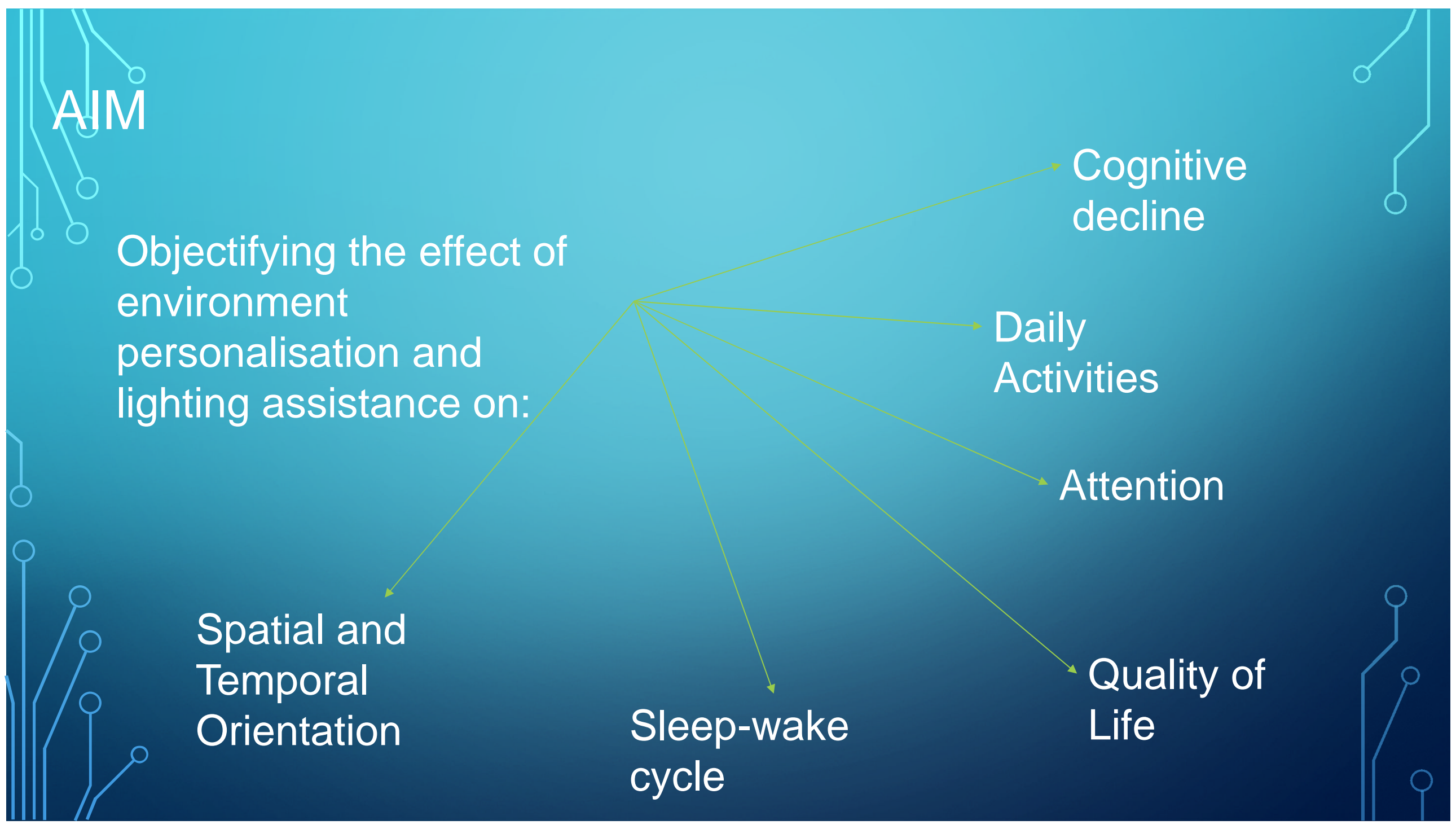
Sleep-wake cycle

Daily Activities

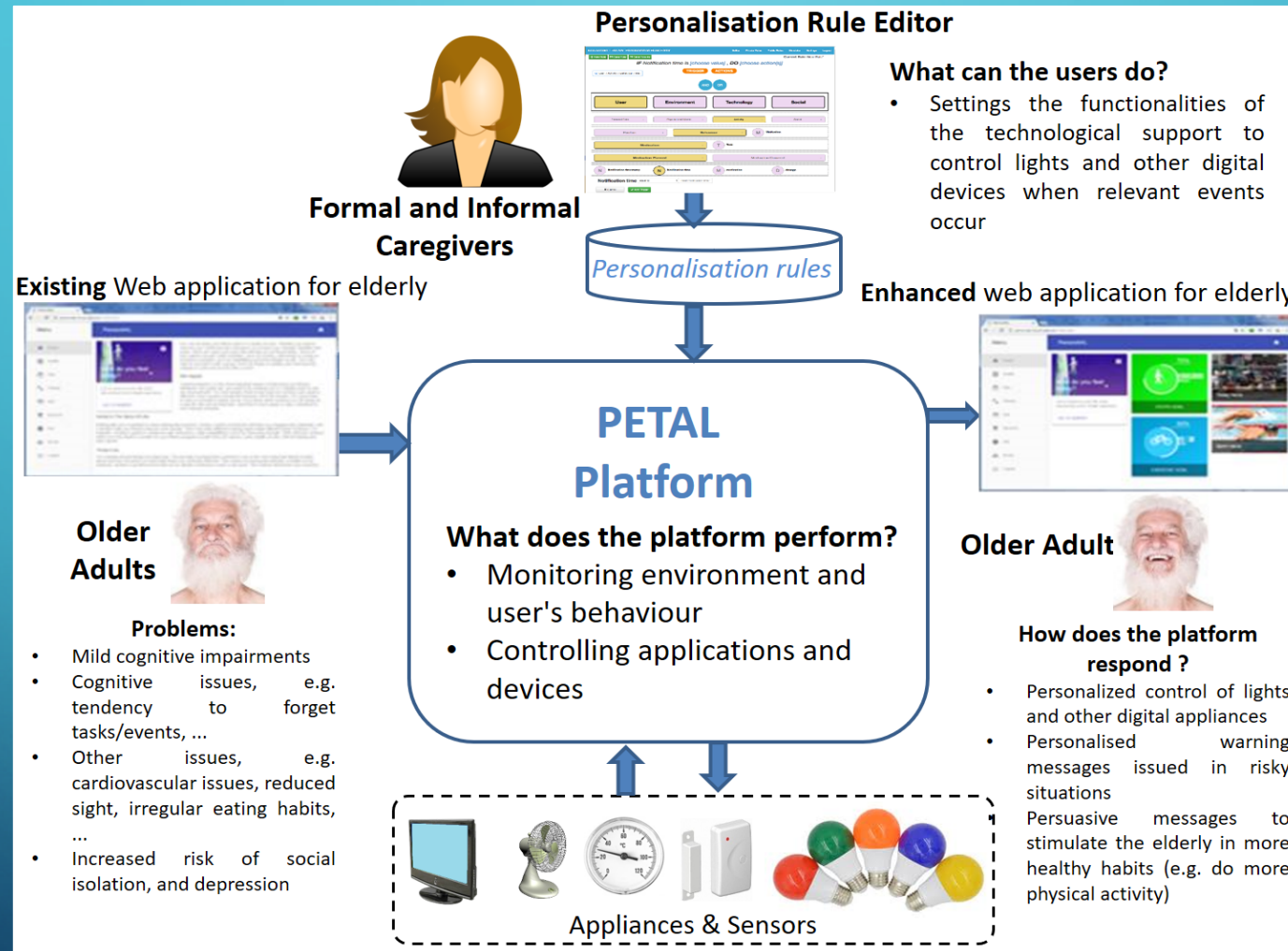
Attention

Quality of Life

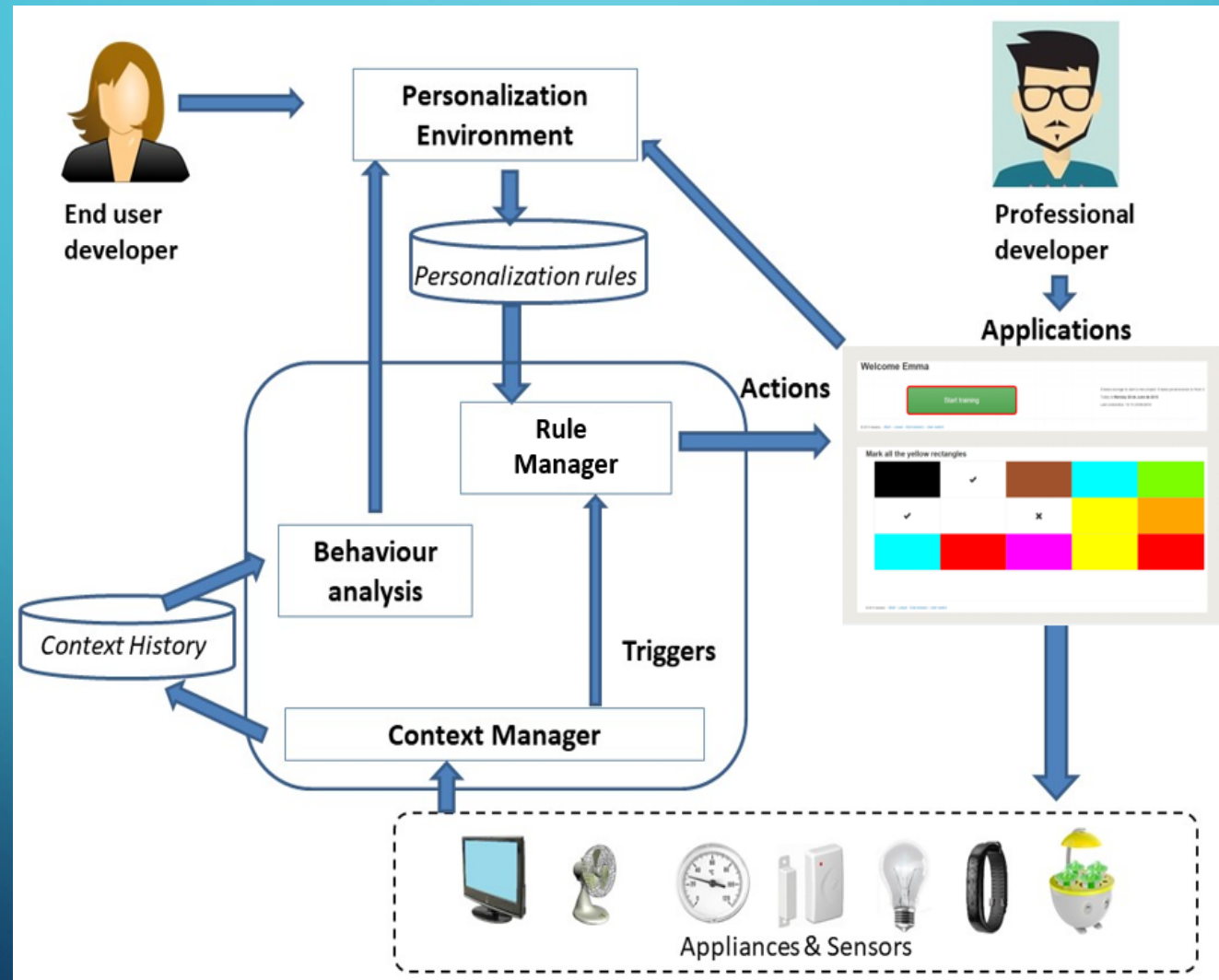
Cognitive decline



PETAL PLATFORM



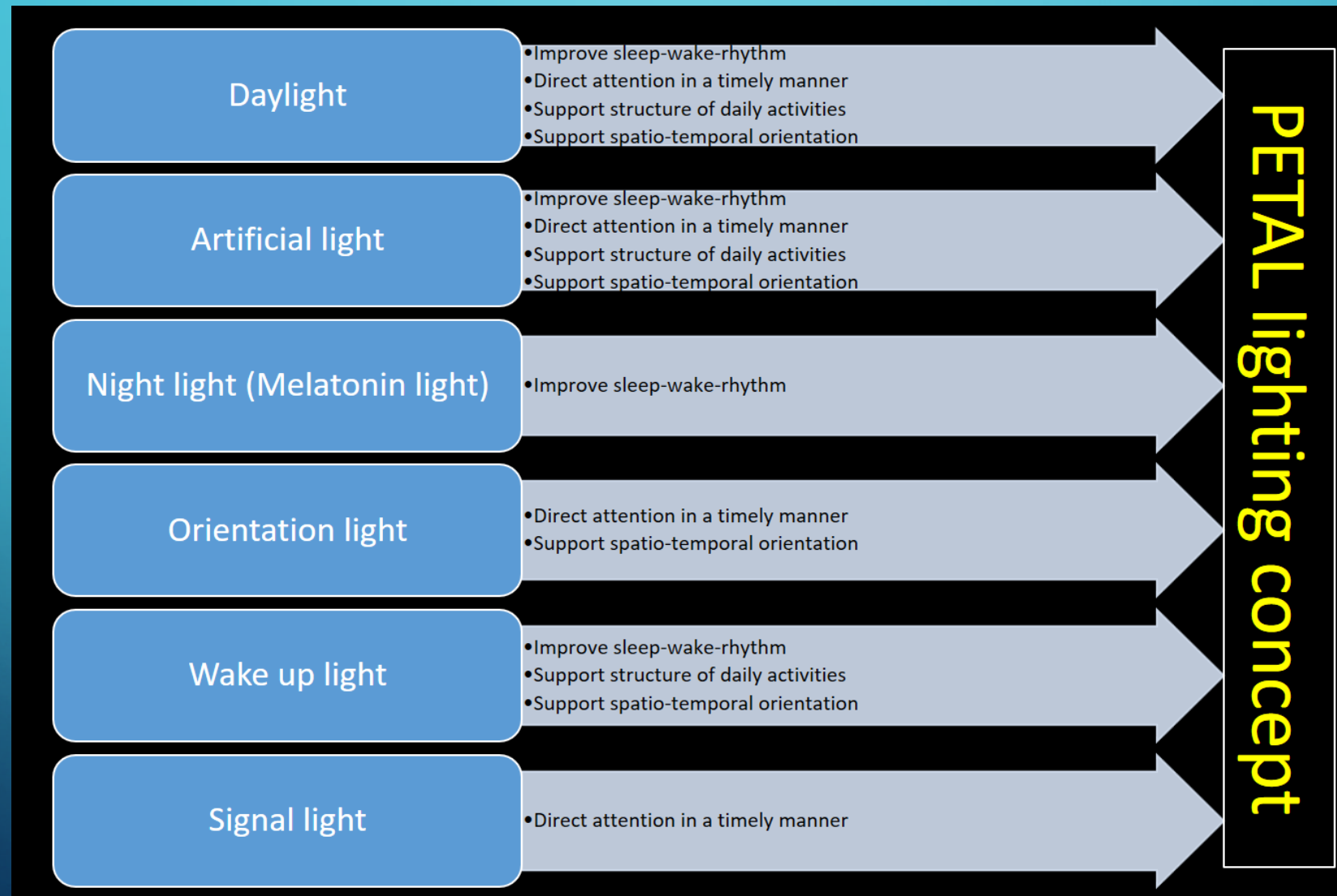
PETAL PLATFORM COMPONENTS



HUMAN CENTRIC LIGHTING (HCL)

- Lighting that induces positive health effects in human beings
- This term was implemented in 2013 into the lighting industry and describes all kinds of lighting that positively affect human beings' mood, alertness, performance, health and well-being
- Usually the following components are considered:
 - 1) use of daylight
 - 2) high-quality artificial light supplementing daylight whenever it is missing,
 - 3) use of sensors to optimize light usage
 - 4) easy-to-use light-control schemes.

PETAL LIGHTING CONCEPT

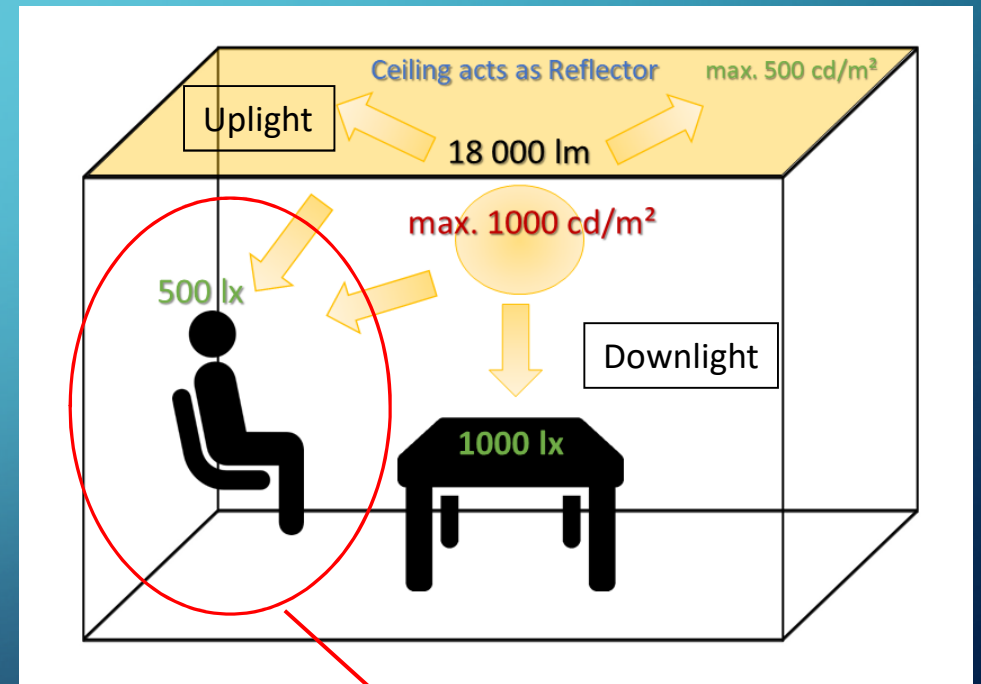
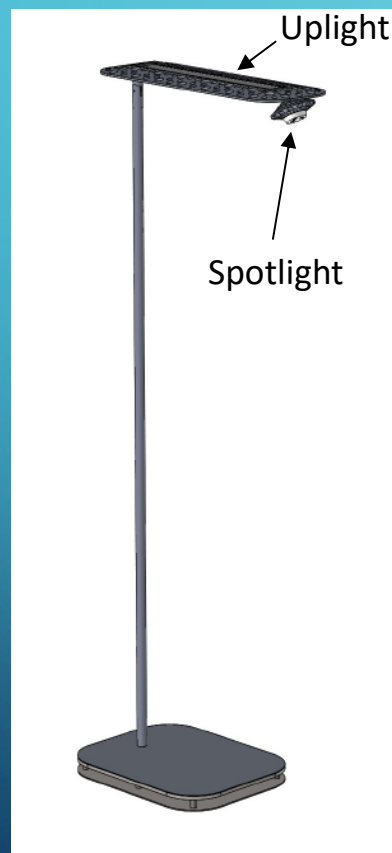
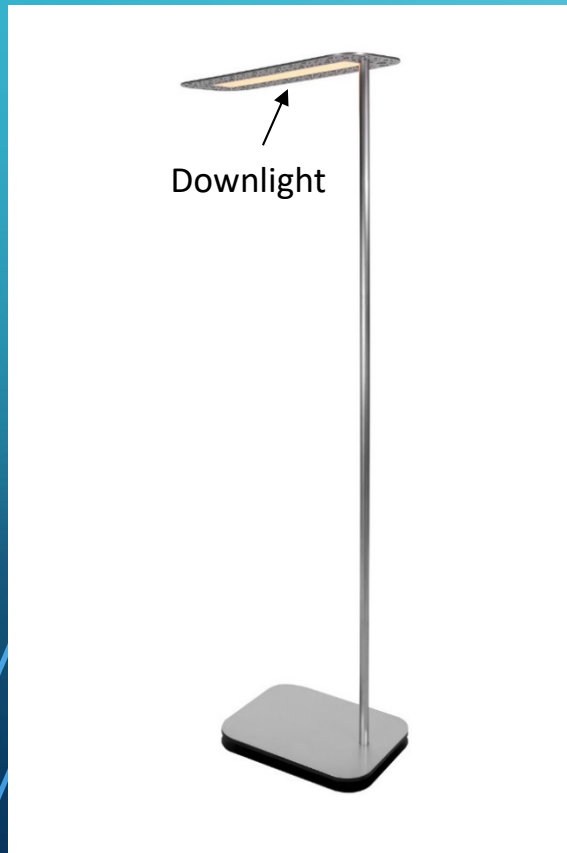


CRUCIAL REQUIREMENTS FOR THE LIGHTING SYSTEM IN PETAL PROJECT:

- 1) All components must be available at the market
- 2) All components must be easily installable
- 3) Each component must have an internet connection to connect it with the PETAL platform
- 4) The whole PETAL system must cost below 4,000 EUR.

PETAL LIGHTING CONCEPT

The GREAT Luminaire



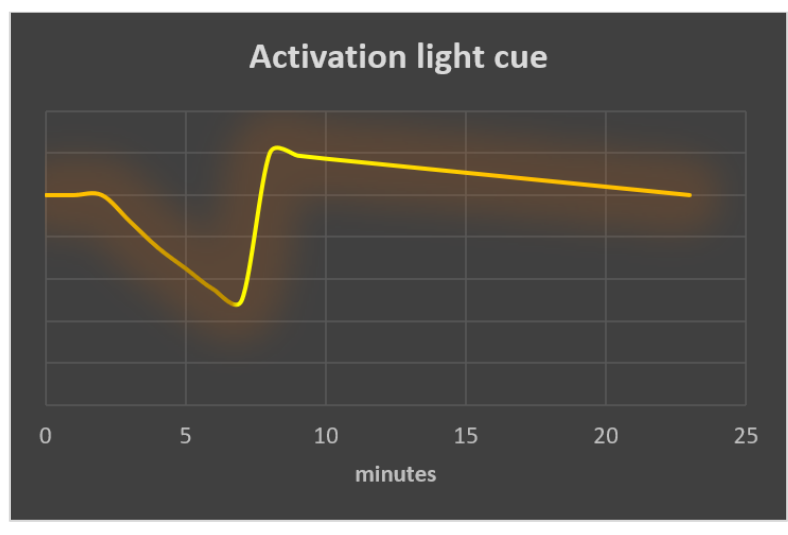
vertical illuminance levels
reaching an observers' eye

PETAL LIGHTING CONCEPT

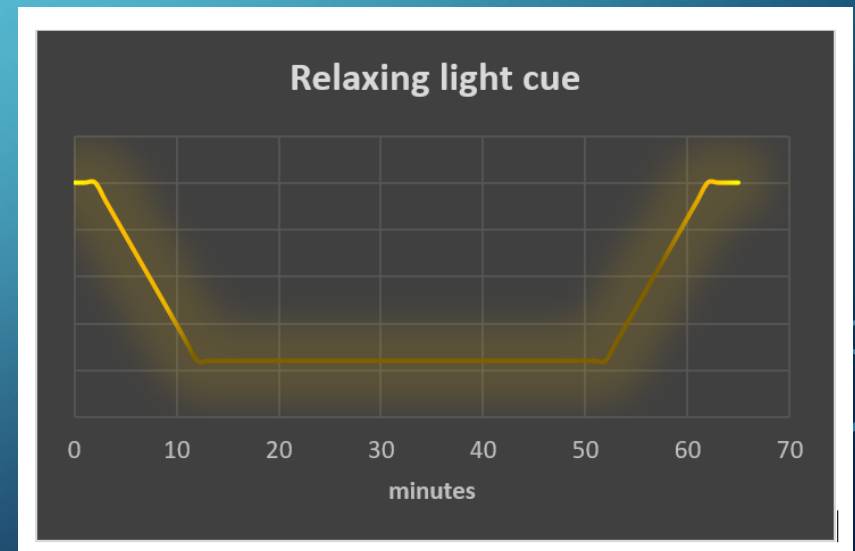
Ambient light scenes for activation and relaxation

The GREAT-Luminaire comes with special light scenes that were developed to have an influence on the acute affective state of an observer. The user can choose between an activating light cue, a relaxing light cue and a “TV”-scene:

- “TV”-scene: a relaxing ambient light setting for activities with low visual demands e.g. while listening to music or watching TV.



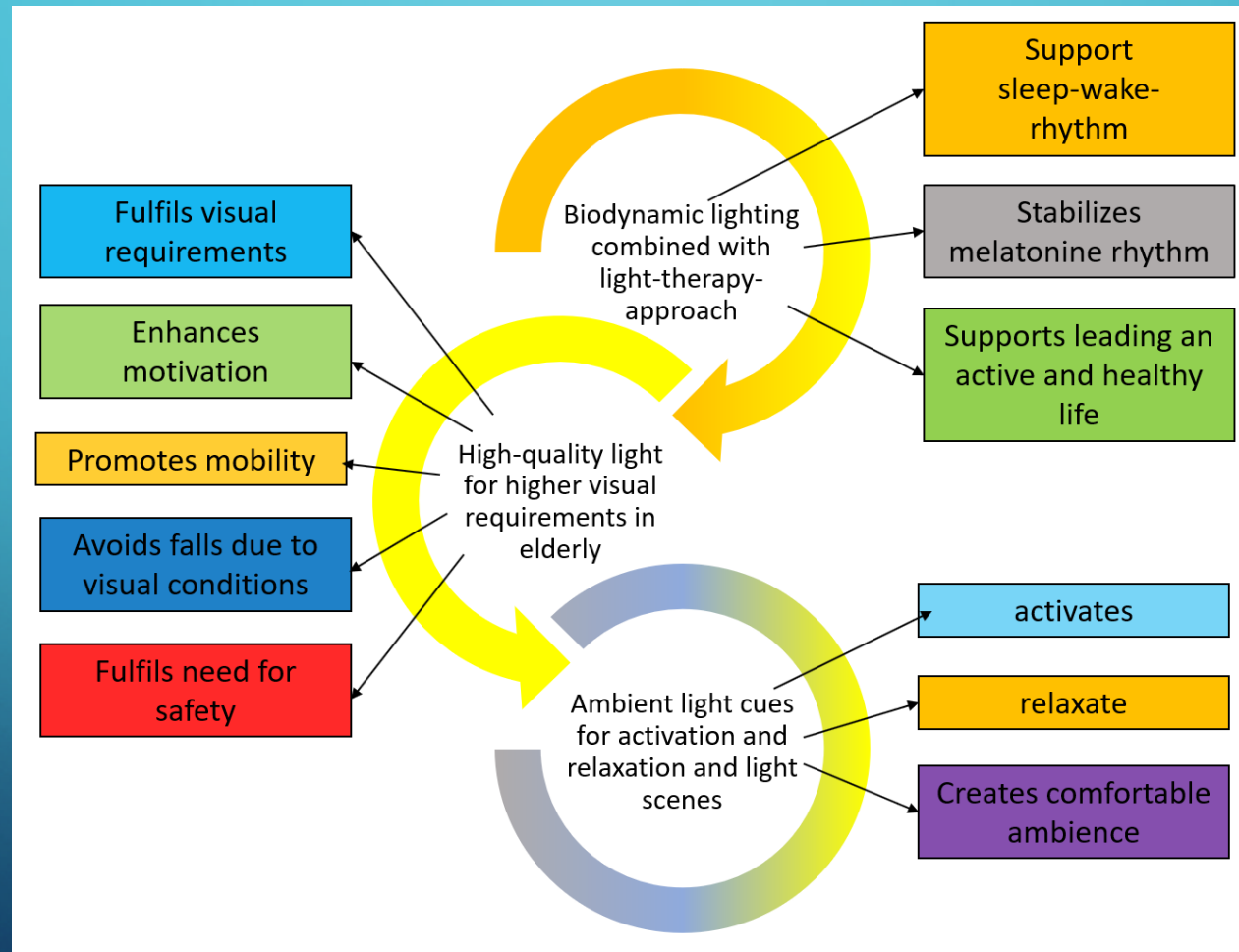
- Activating light cue: studies showed that light with specific color temperature and intensity can be used for acute alerting effects (Yang et al., 2018).



- Relaxing light cue: a reduction in light intensity and color temperature directly lead to a feeling of comfort and relaxation.

PETAL LIGHTING CONCEPT

Light effects of the GREAT concept



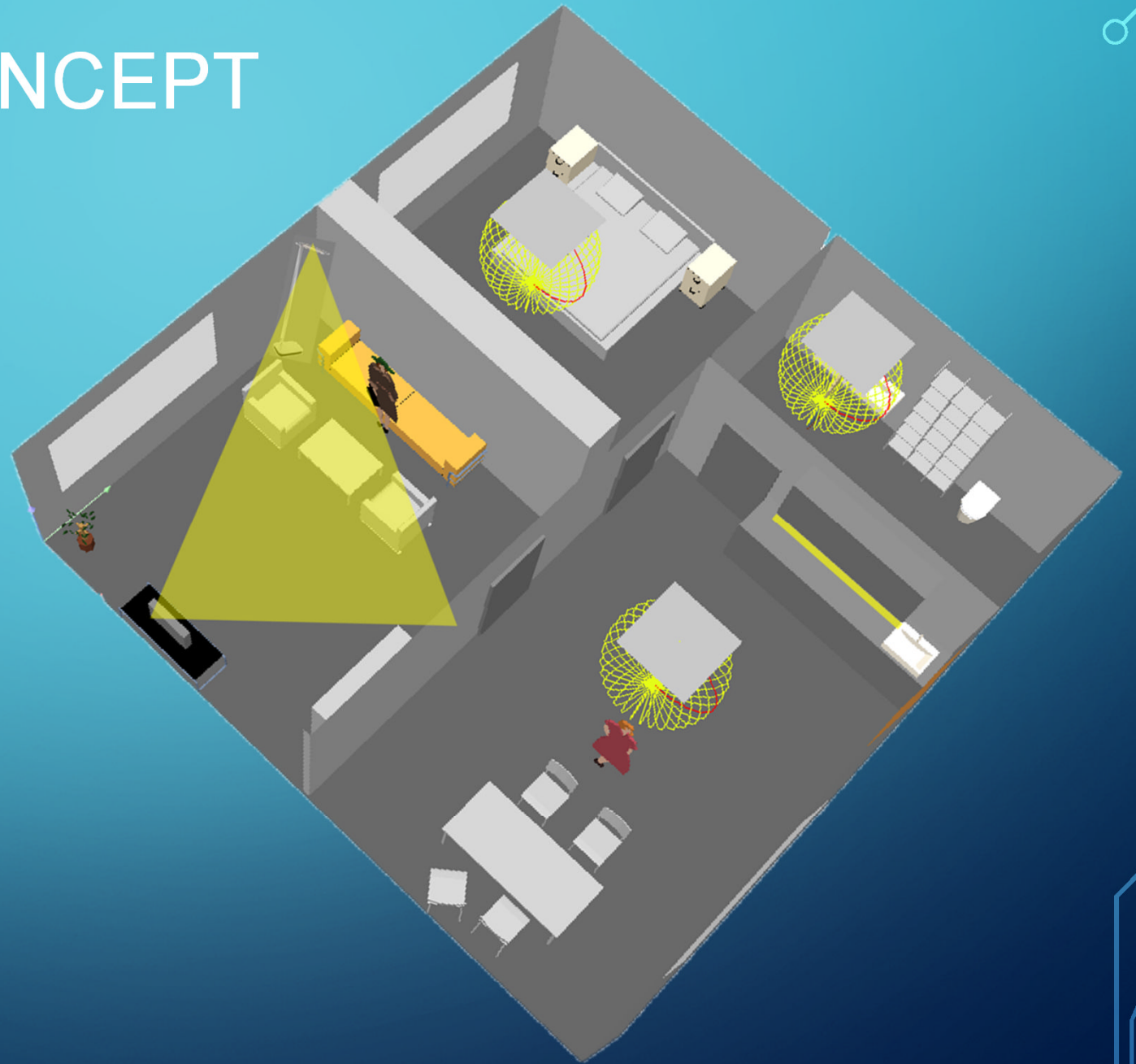
PETAL LIGHTING CONCEPT

Examples of rules using light

Rule no.	Rule name	Trigger	Action
1	Use daylight outside	IF there is bright daylight	THEN remember person to go outside
2	Use daylight inside	IF daylight is insufficient at the most common place (e.g. couch)	THEN remember person to go to brighter areas in the flat
3	Use artificial bright light	IF there is not enough daylight in the flat	THEN artificial light should turn on
5	Wake up smoothly with light	IF the person should be waked up	THEN the wake-up light turns on
6	Use alarm light for oven	IF the oven has left on after leaving the kitchen	THEN the signal light should turn on (red alarm)
7	Inform caregiver in emergency case	IF there is light in the bathroom during the night for more than 2 hours	THEN give an alert message to his/her caregiver/relative
8	Prevent falling at night	IF the person stands up during the night	THEN the orientation light turns on guiding the way to the bathroom
9	Healthy biodynamic light	IF the person is inside the flat	THEN biodynamic light will be used in all occupied rooms

PETAL LIGHTING CONCEPT

Prototype flat equipment



ACKNOWLEDGMENT:

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THANK YOU