Lighting Control User Interface Standards

User Interface standards have been an essential component of our devices for many decades, from communication (e.g. phone keypads) to vehicle controls (e.g. dashboard controls). These are most effective when documented and formalized into technology standards, though sometimes can be accomplished through de facto convergence as is the case with many user interface elements (mainly symbols and terms) in IT systems. User interface standards enable interoperability between devices and human beings. Lack of UI standards makes it either more difficult for the user to obtain what they want, or they fail to accomplish that. For energy-relevant user interfaces, this often results in wasted energy, so that achieving more consistency in user interfaces is a nearly free way to save energy.

 Lighting controls currently lack any user interface standardization, at the national or international level, though some generic user interface elements do apply to lighting. Over the past decade, LBNL has conducted several surveys of lighting controls on the market, as well as a survey of relevant standards. From this, we produced a proposal for an initial lighting control user interface standard, along with a discussion document to explain the choices made in constructing the proposal. It begins with core concepts such as the general concept of lighting, on/off control, and brightness control, along with several others. For some we were unable to identify suitable content to propose, as with scene, color selection, and accessibility. The U.S, committee ANSI/NEMA C137 currently has a working group to create a proposed U.S. national standard, with the intent that an international version adapted from this be created after that.

Bruce Nordman

Bruce Nordman is a Research Scientist at Lawrence Berkeley National Laboratory. His work focuses on the intersection of energy use and efficiency with IT and network technology. He has worked to advance physical layer technologies, application layer protocols, system architectures, and user interfaces (the '8th layer' of the OSI model)

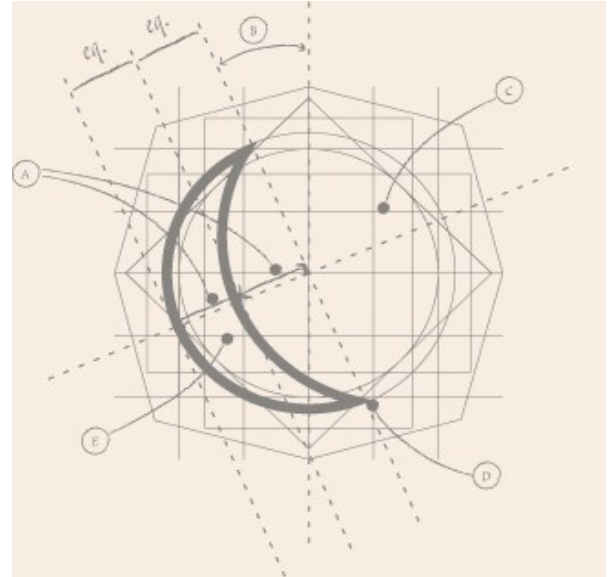# Lighting Control User Interface Standards

Bruce Nordman

Lawrence Berkeley National Laboratory
bnordman.lbl.gov – nordman.lbl.gov – 510-486-7089

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Overview

- Why

- Process

- Proposed Standard Content

- Discussion

Why Light UI?

- Lighting and controls …
  - rapidly becoming more capable
  - responsive to needs, desires, presence, etc.

- … so becoming much more complex

- No standards for how devices should communicate with users

- Result
  - mismatch between what people want and what they get
  - wasted energy

- In other domains we use UI standards

  - Vehicles, communication, power control, safety, ….

Example: Power Control

Basic Concept: Power State
- 3 basic power states: On, Sleep, Off
- Standard mapping to indicator lights
  - **Green**, **Yellow**, **Off**
- Clear and self-consistent terminology

- Symbol usage | ○ ⏻ ⏽ ☾

- Application details
  - Hibernate, accessibility, transitions, …
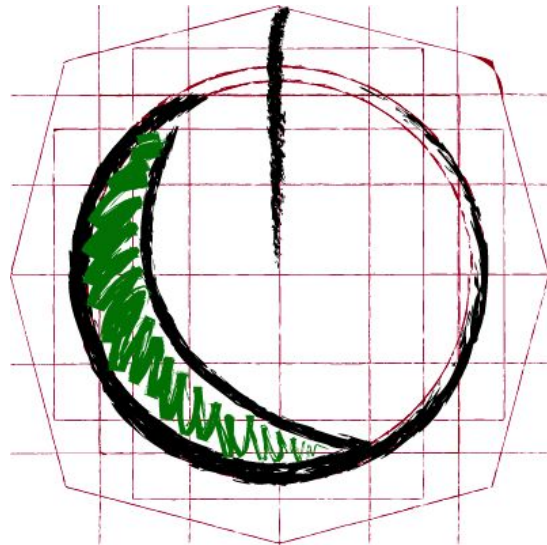
IEEE 1621: User Interface Elements in Power Control of Electronic Devices Employed in Office/Consumer Environments

UI Standards: Scope / Coverage

Visual elements
- Terms
- Symbols
- Colors

Audio elements
- Sounds
- Words

Concepts
- "collections of meaning"

Dynamic content
- Indication
- Actuation

Tactile elements
- Identification
- Actuation

Appear in hardware, software, documentation, culture, …

Process
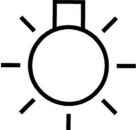
- 2009-2011 – Initial research project [report]
- 2016-2019 – Second research project
  - February 2017 – Product Survey [report]
  - August 2017 – Proposed Standard content and Rationale discussion [documents]

- NEMA C137 - Lighting Systems

  - March 2017 – Concept introduction to NEMA [slides]

  - August 2017 – Draft Proposed Standard content and Rationale presented
    - Draft Proposed Standard content; Rationale discussion [2 reports]
  - Later – NEMA committee created

Integration into product design can occur <u>at any time</u>

Concepts
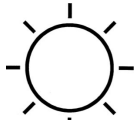
- General Principles

- Lighting in General
- Basic Switching
- Brightness
- Dynamic Control – Occupancy
- Dynamic Control – Daylight
- Color Temperature
- Other
  - Color, Speech, Shading, Accessibility

General Principles; Lighting in General

- Define language of terms, symbols, colors, metaphors, ….
  - NOT how to use it
- Avoid or explain "secondary actuation" for ordinary tasks
- Use standard physical mappings
  - On/more is: Up, Right, Clockwise, Away (from user)
  - Off/less is: Down, Left, Counterclockwise, Towards (user)
- +, -, △, ▽   for more/less

- Lighting in General - ☼-

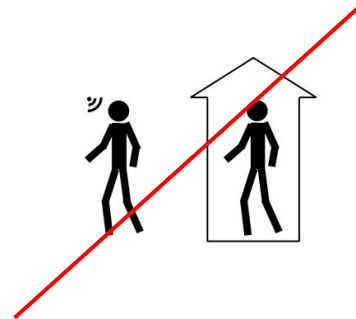# Basic Switching; Brightness (not dimming)

- Use "power state"; standard symbols –
- Use standard physical mappings

- "Brightness" –
- Scale should match human perception
- Symbols for 'variable control' –
- Use standard physical mappings

Dynamic Control - Occupancy

- Concept
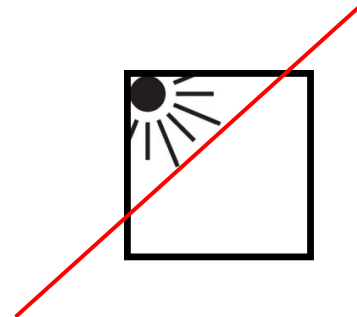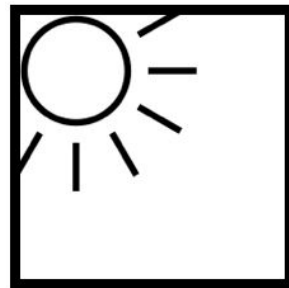 - Useable on sensor, control, or controlled light

- Person 'in room' or 'sensed'
  - *Which one? Or something else?*
  - *How to indicate Unoccupied?*

- Convey movement
  - Not restroom
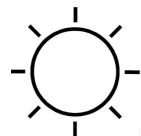
Dynamic Control - Daylight

- Concept
  - Useable on sensor, control, or controlled light

- Daylight
  - Light entering via window
  - Standard symbol "colour temperature, natural light"
    - Other is "high protection against sunglare"

- More and longer rays than Brightness -

Color - "Color Temperature"

- Air/water temperature: cool is lower than hot
  - Cool to left; warm to right
  - Color temperature is backwards
  - This is/will be confusing; endlessly

- Propose adopting a different metaphor
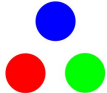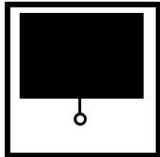 - Color temperature is different anyways

- "Color Time"
  - Morning: blue/cool
  - Afternoon: yellow/warm

- Symbol: Sun path plus light bulb
  - Southern hemisphere an issue?

Color; Speech; Other

- Color –   ⬤ (later: color selection)

- Speech – TBD (but soon)

- Other
  - Shade – "On" is maximum shading
  - Symbol for shade control –
  - Accessibility – *what to include?*

Discussion

- Concept

- Content

- Process

Thank you