# Customizability in Preventing Loss of Interest in Ambient Displays for Behavior Change

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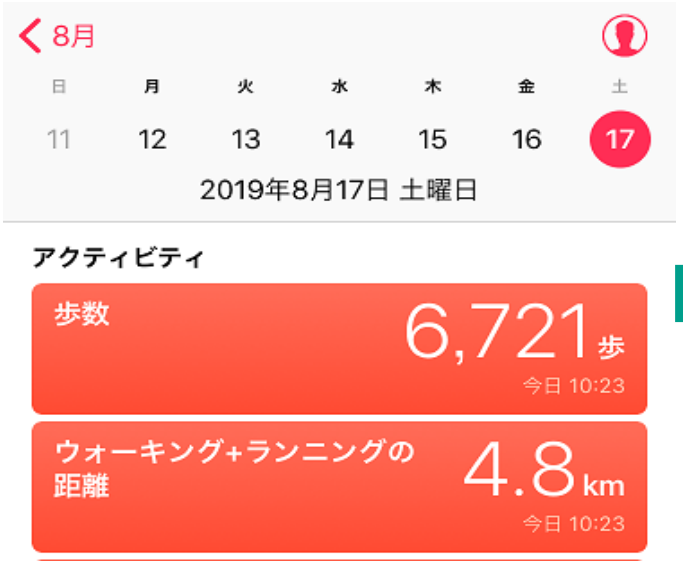
# Background: Ambient displays




Traditional approach

Ambient display [1]

- Rich visual elements
- Information can be easily understood.
- Often used in the research of behavior change

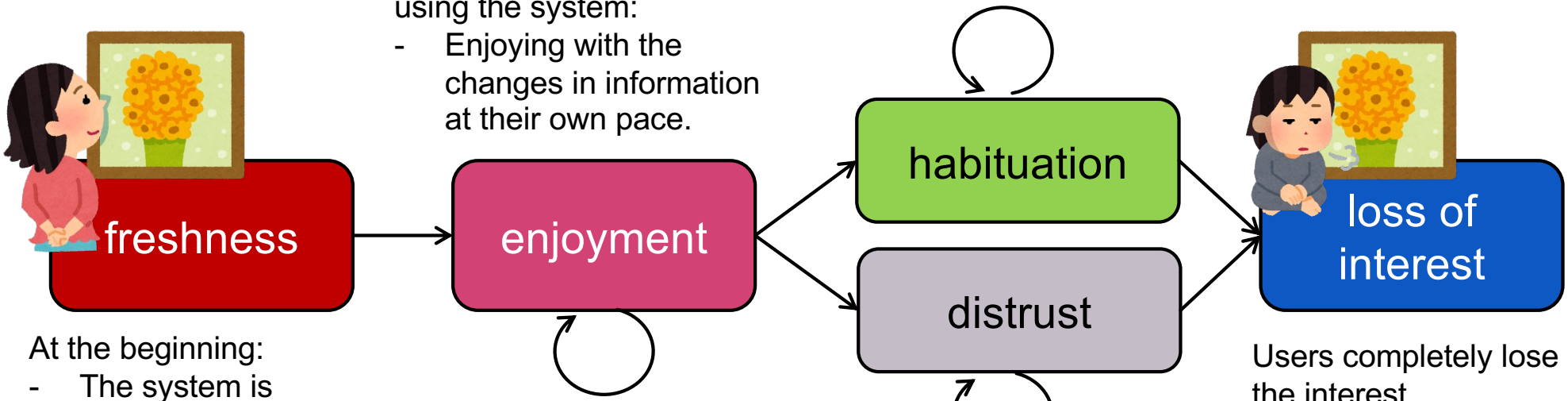
[1] J. Froehlich, et al., “Ubigreen: Investigating a mobile tool for tracking and supporting green transportation habits,” CHI’09.

## Problem in long-term use

- Loss of interest
  - The system's effects on behavior change may be diminished.

# Background: A model of Losing Interest

Modified a model of mental states of children playing with robots [2] to fit with long-term use of ambient displays by adding two elements: habituation and distrust.




At the beginning:
- The system is unknown to the user.
- Interest level and the use frequency are high.

Finding their own ways of using the system:
- Enjoying with the changes in information at their own pace.

Users may get accustomed to the system:
- Feeling that all the functions and patterns have been explored.
- Perceived as background images.

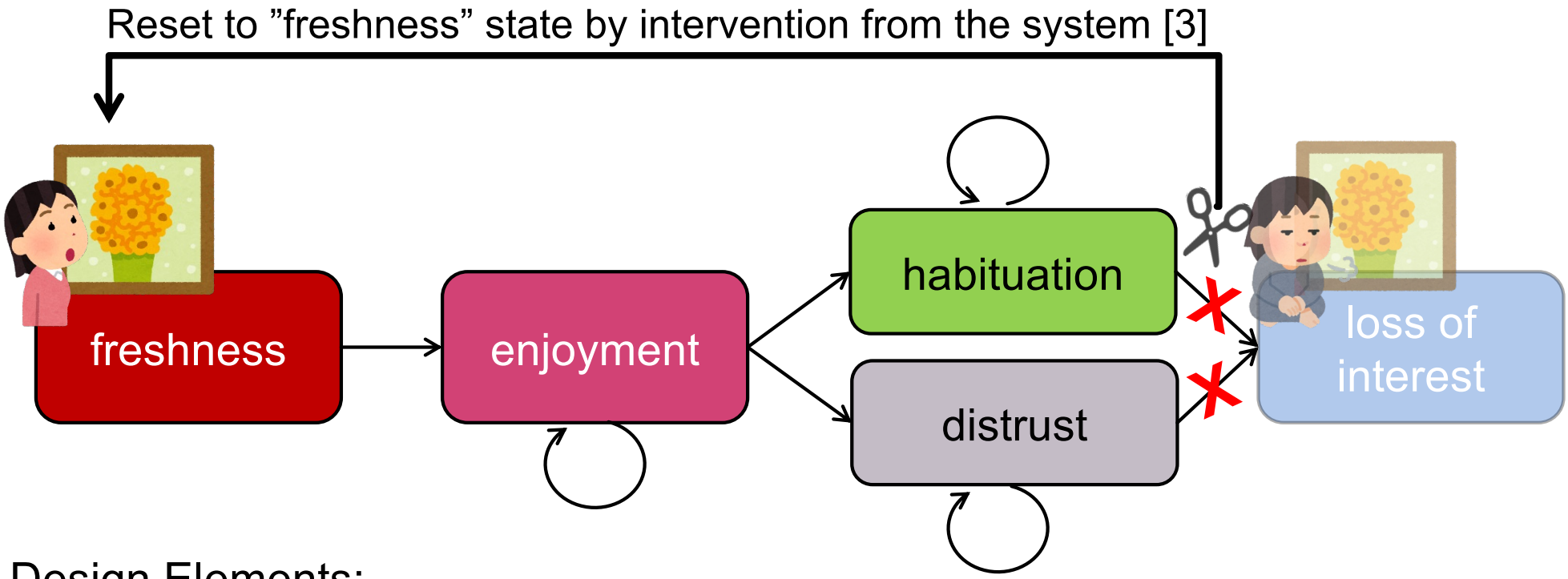
Users may distrust the system:
- Inaccurate sensing may make them feel that the system does not follow their wishes or information.

Users completely lose the interest
- Ignore the system

[2] K. Abe, et al. “Robots that play with a child: Application of an action decision model based on mental state estimation,” *Journal of the Robotics Society of Japan*, 31(3), 2013.

# Our approach

Detect the signs of loss of interest and intervene the user to address the states before the users completely lose interest.




Design Elements:

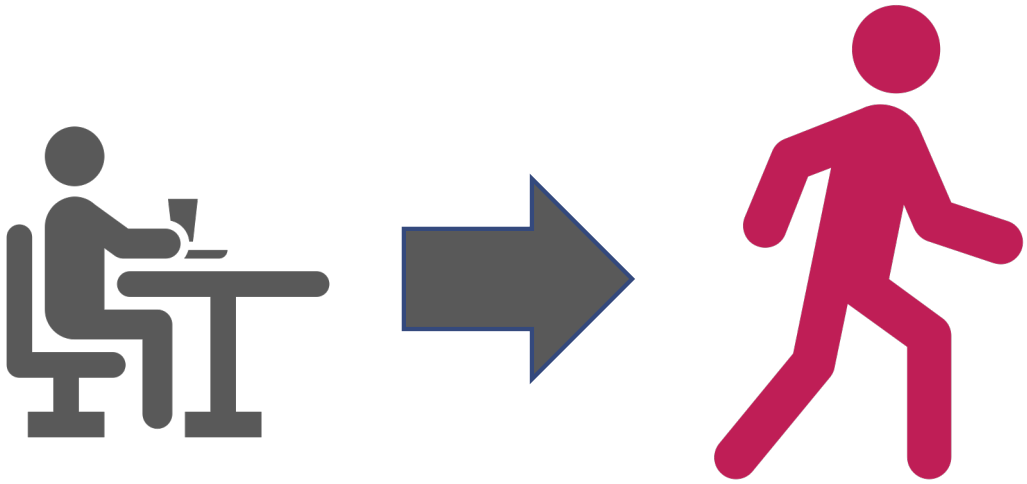
- What are the signs of loss of interest?
- How to detect them?
- How to address the states of “being losing interest”?

[3] S. Kunikata, et al., “Involvement of a system to keep users interested in the contents of ambient persuasive display,” GCCE2021.

# Experimental Prototype System: Design and Implementation

# Target behavior change

Increased sedentary time and deteriorating health due to increase time at home in CoVID-19 era



*Be active at home in ”stay home” campaign of CoVID-19 era, e.g., moving around and performing exercises*

# System overview

Note: b1, b2, d1, d2, and e represents the subfigures in the next slide

- Basic feedback
  - Employs a growth metaphor
    - Positive feedback: A virtual tree grows when the non-sedentary time per hour ($HA_h$) exceeds a certain ratio ($th$): (b1)
    - Negative feedback: A virtual tree gets thinner if $HA_h$ does not exceed $th$, and the tree breaks at the fourth stage: (b2)
  - Aims at improving behavior through the aspiration to increase tree growth.

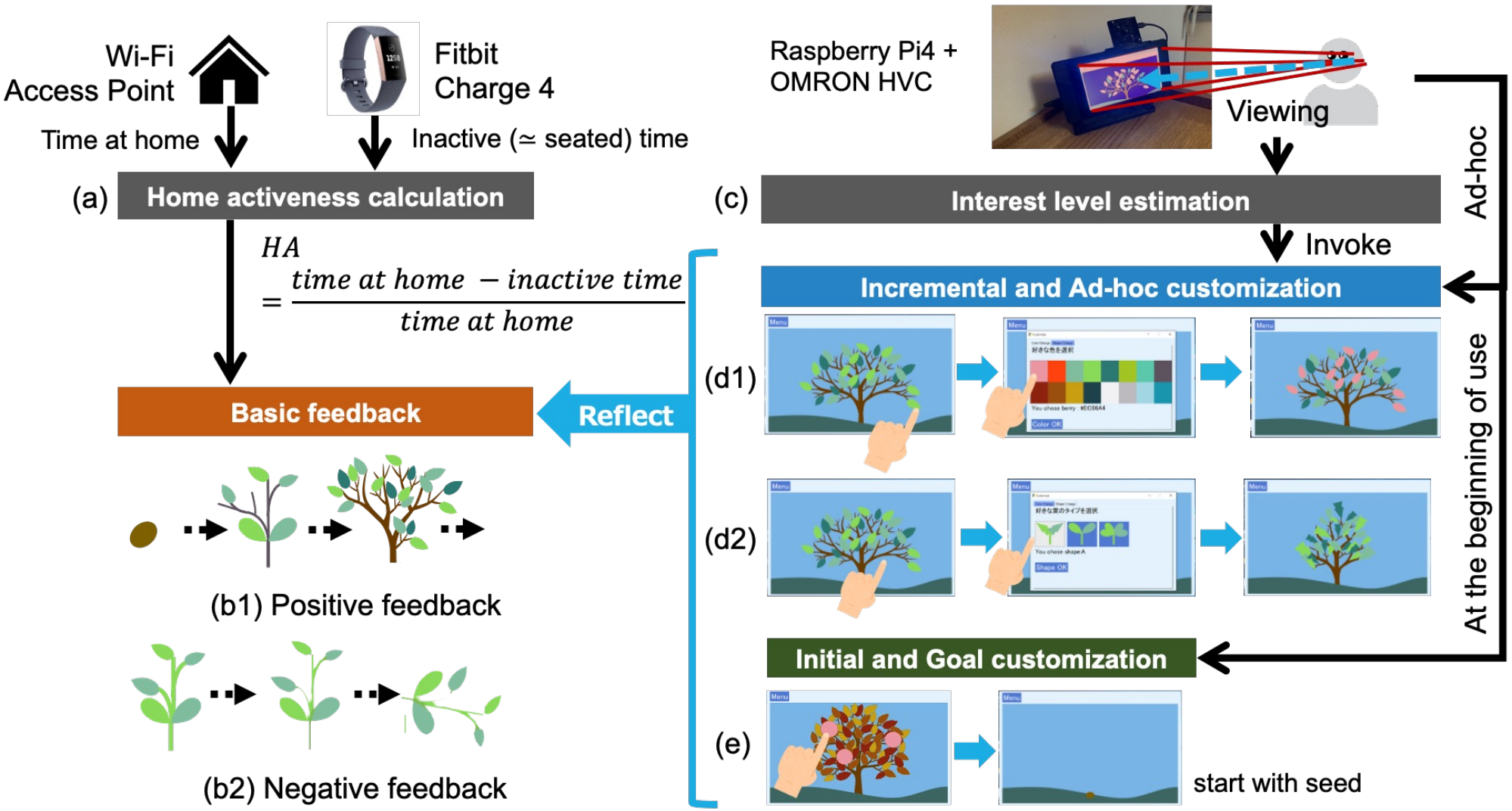
$$HA_h = \frac{time\ at\ home_h\ - inactive\ time_h}{time\ at\ home_h}$$

# $HA_h$ (Home Activeness) between hour $h$ and $h+1$ : (a)

- Two types of active involvement strategies
  1. Incremental and ad hoc customization: (d1) and (d2)
  2. Initial and goal customization: (e)

→ To be evaluated

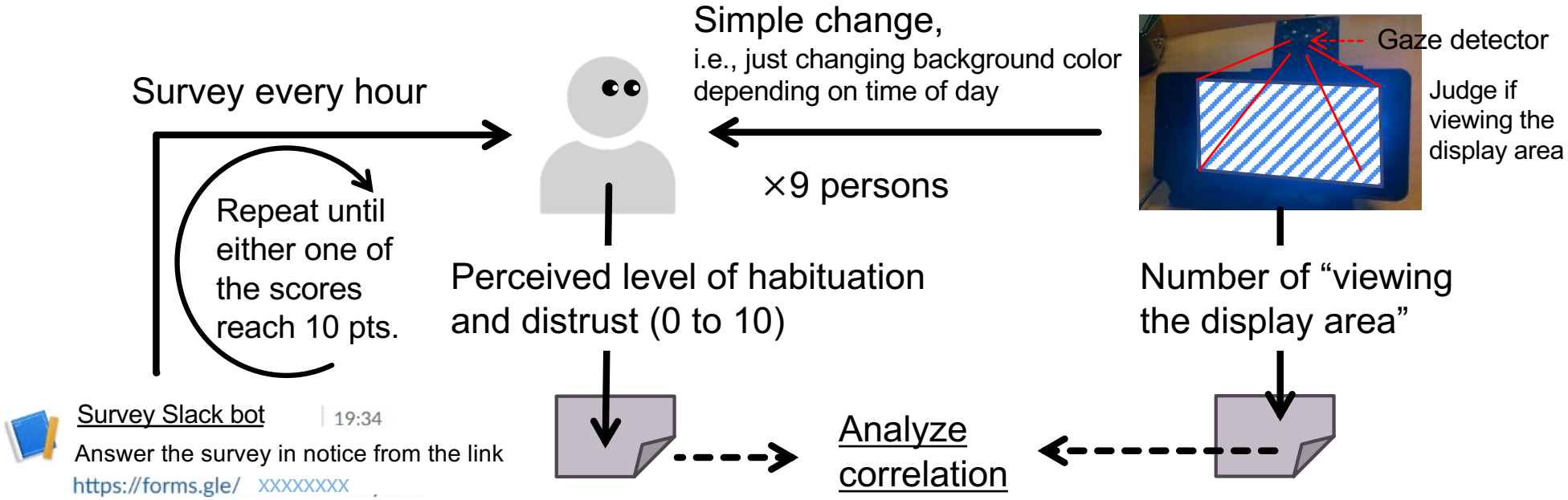
# Major functional components



# Interest level estimation

## Hypothesis

- A negative correlation exists between the frequency of display viewing and the level of habituation and/or distrust




## Result

- Negative correlation (mean (S.D.): -0.60 (0.39)) was found in 8/9 persons.

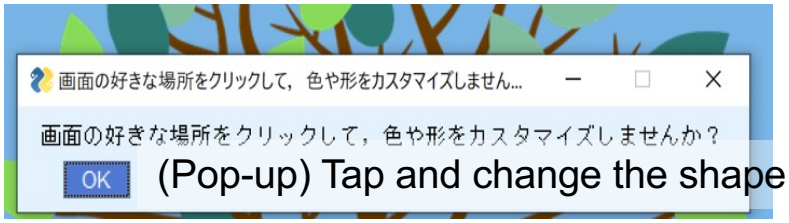
The frequency of viewing the display decreases as the interest is lost.

# Customization 1: Incremental and ad-hoc customization

## Triggered by the system

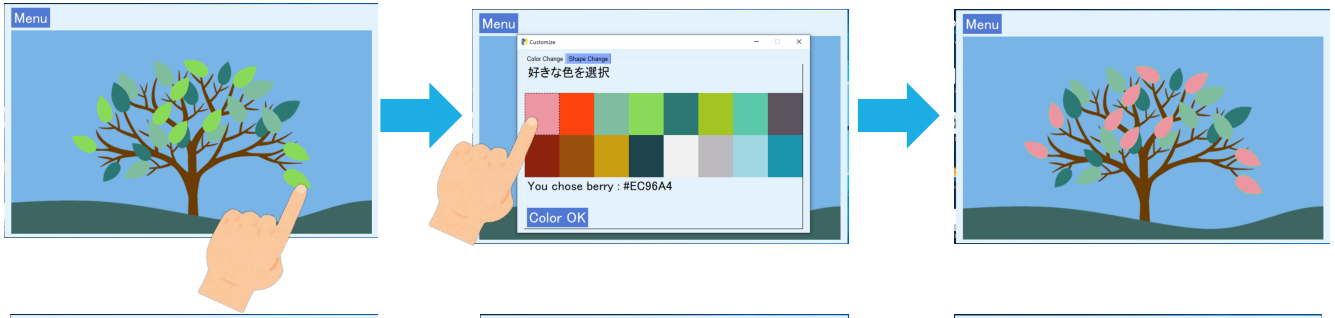
$$Interest\ loss\ ratio = \frac{VF_t}{VF_{1st}} < 0.516$$

- $VF$: Viewing Frequency
- $VF_t$: VF at time $t$
- $VF_{1st}$: VF on the 1st day of use

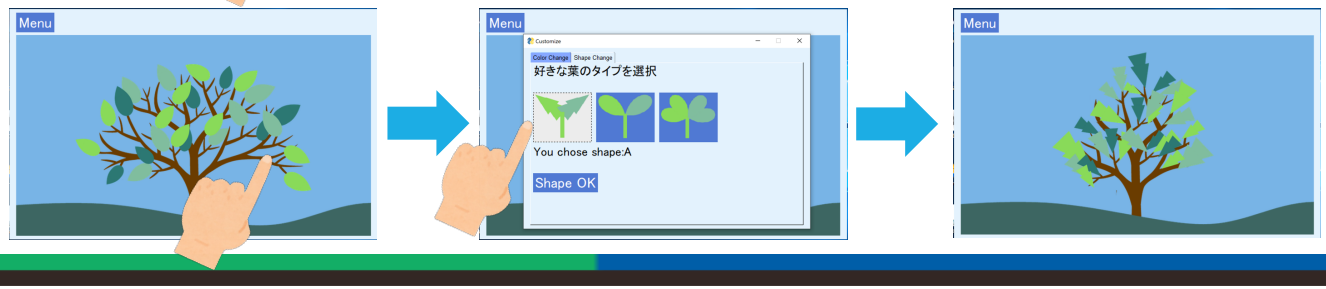



(Pop-up) Tap and change the shape or color!

(d1) Color




(d2) Shape



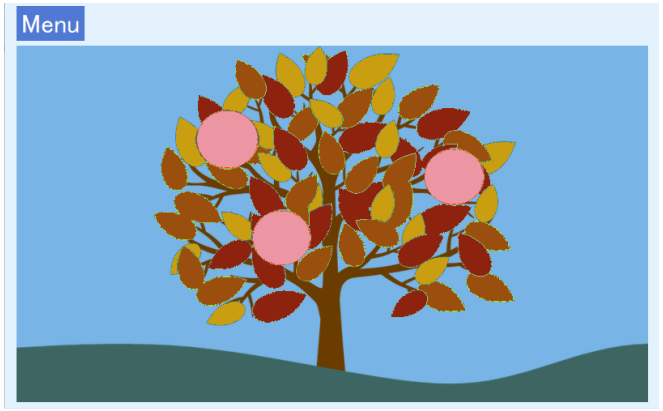

## Triggered by the user

Can be changed at anytime

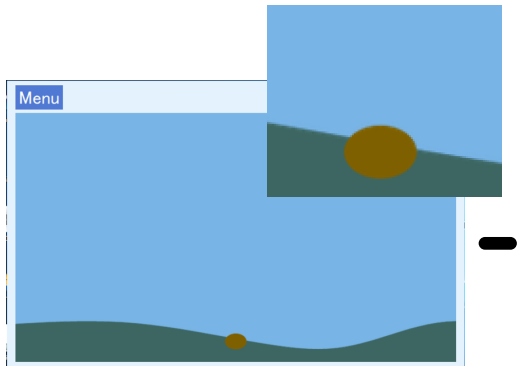
# Customization 2: Initial and goal customization

**Set the goal appearance before use and the user aims for it.**

(e)




Before start of use
- Set the shape and color of tree




1st day: Start with a seed


Nth day: End with the desired appearance

# Experiment

# Objectives and Methodology

## Objectives

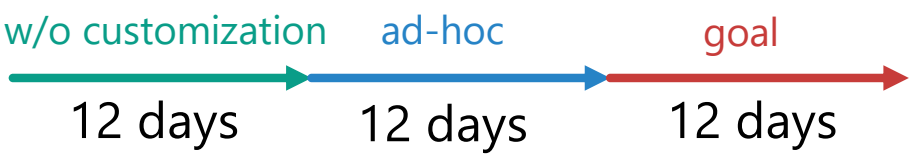
Investigate the effectiveness of the proposed feedback and customization methods

## Methodology

- Six university students (20s; two females and four males)
  - Not given any specific instructions regarding their time at home

- Three conditions, i.e., system configurations, 12 days each (5 weeks in total).
  - With ad-hoc customization
  - With goal customization
  - Without customization (baseline)

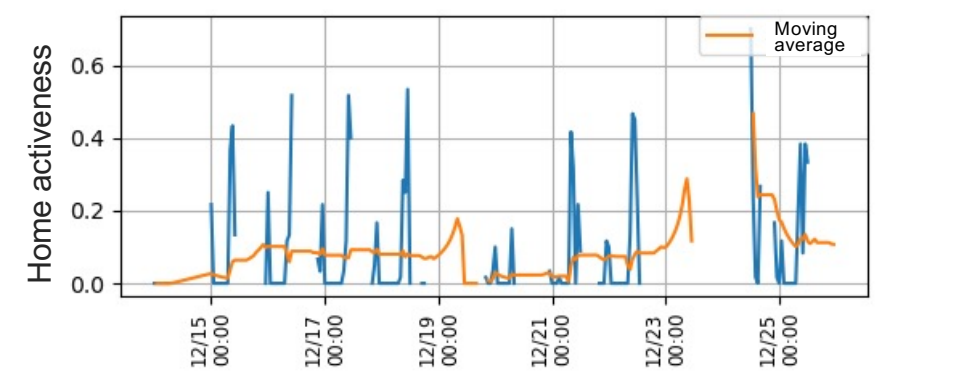
e.g.,

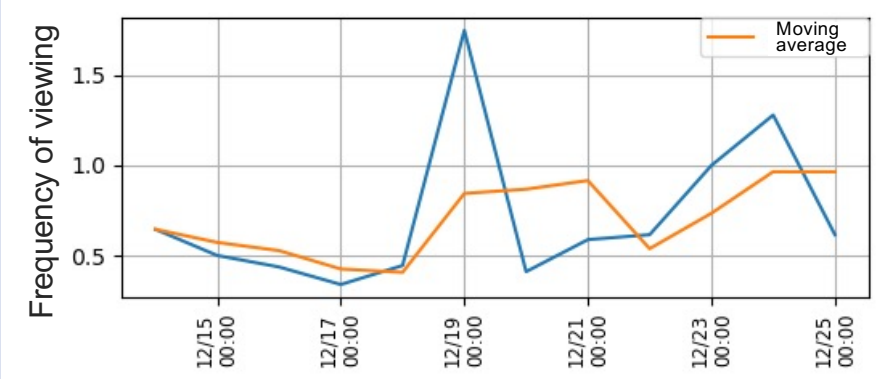



- Evaluation items
  - Quantitative: viewing frequency (VF) and home activeness (HA)
  - Qualitative: Questionnaire survey at the end of each condition

# Result: Effective customization method by user type (1)

- Highly Motivated (HM): 3 persons
  - High home activeness (HA) and view frequency (VF) throughout experimental period
  - Preferred: Ad hoc customization > goal customization > baseline



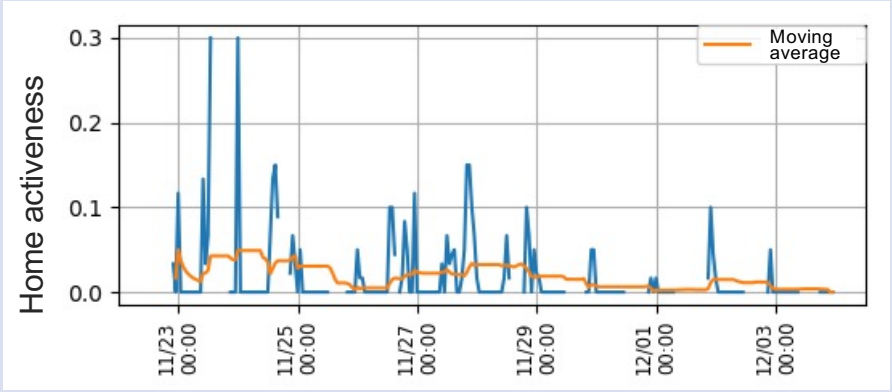

Time trends of a participant in the HM type who used the system without customization (baseline) for the third option.

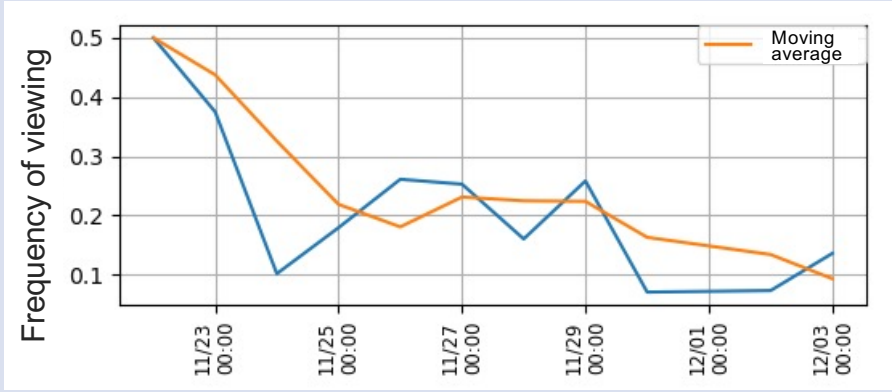
- Highly motivated by tree growth
- Changing the appearance of the tree made me refresh.

- Gradually forgot the goal appearance (in condition of goal customization)

# Result: Effective customization method by user type (2)

- Gradually Un-Motivated (GUM): 2 persons
  - HA and VF gradually decreased.
  - They preferred goal customization, allowing them to set a goal tree first.



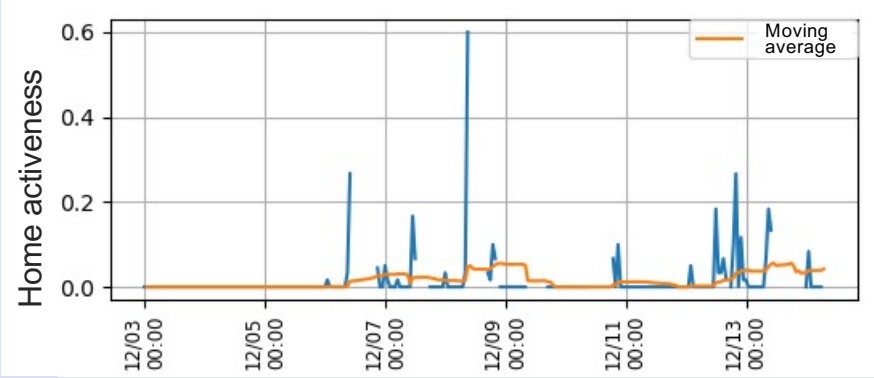

Time trends of a participant in the GUM type who used the system with goal customization as the first option.

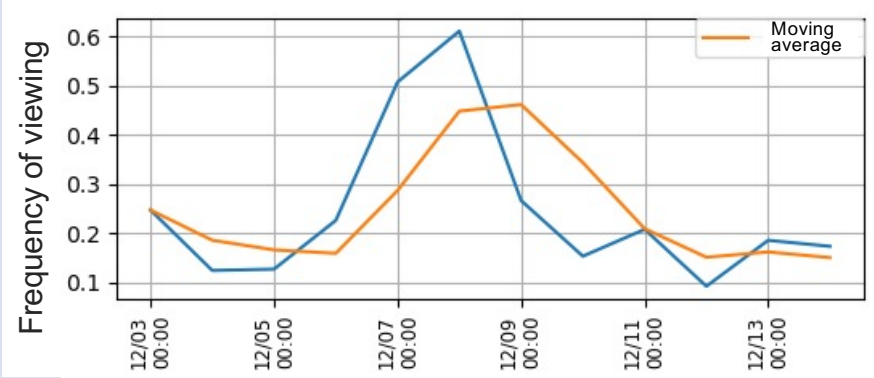
- At the beginning, motivated to some extent

- Lost interest in the middle of experiment
- Never used ad-hoc customization that need voluntary operation

# Result: Effective customization method by user type (3)

- Poorly Motivated from the beginning (PM): 1 person
  - Low HA from beginning to end.
  - Tended not to use the system continuously




Time trends of a participant in the PM type who used the system with goal customization as the second option.

- Unaware of the risk of being sedentary at home
- Not conscious enough to change behavior through an ambient approach

# Conclusion

# Conclusion

- Findings
  - Correlation between viewing frequency and loss of interest
  - Effective system intervention methods for loss of interest differ depending on the type of user.
    - HA: Ad-hoc customization was effective.
    - GUM: Setting goal at the beginning was important.
    - PM: The importance of changing behavior should be communicated.
  - Distrust of the system
    - Feedback rule, e.g., Tree growth was only for time spent in the house although the user was active in the office.
    - System malfunction, e.g., failure in synchronizing between health tracker and the ambient display
- Future work
  - Intervention strategies should be tailored to users' motivations and lifestyles
  - The method of handling distrust of the system should be investigated.