Human Affordance as Life-Log for Environmental Simulations

Masayuki Ihara[1], Minoru Kobayashi[1], and Takahiro Yoshioka[2]

[1] NTT Cyber Solutions Laboratories, NTT Corporation
1-1, Hikari-no-oka, Yokosuka, 2390847 Japan
{ihara,minoru}@acm.org
[2] Graduate School of Information Science and Electrical Engineering,
Kyushu University, 744 Motooka, Nishi-ku, Fukuoka, 8190395, Japan
takahiro.yoshioka@inf.kyushu-u.ac.jp

Abstract. This paper presents the design principle of establishing environmental simulation systems on the "human affordance" collected as user life-log. We envisage that combining life-log applications with a consideration of cognitive science will yield better life-log utilization. Research questions in this study are how to collect life-logs without user resistance to exposing the logs and how we can continuously utilize the latest life-logs. Our answer to the first question is to transform the recorded data to the extent that the user willingly accepts the automatic release of his/her life log. Our answer to the second question is to employ the affordance theory in cognitive science.

Keywords: Life-log, human affordance, transformation, environmental simulation.

1 Introduction

A variety of life-logs can be recorded in our daily life such as location data or device operation history. These life-logs can be used to create recommendations based on an inference of user preferences or activities. Such recommendations are a user-feedback type of service. We note that the life-logs from many users in the world could be used for environmental simulations, which will play an important role in visualizing future problems with the earth and the identification of solutions (Fig. 1). In order to achieve such simulations, it is important to well design the system, which must integrate user devices, networks and simulation servers. To determine the design principle for these system, this study addresses the research questions of how to collect life-logs without user resistance to exposing the logs and how we can continuously utilize the latest life-logs. Our answer to the first question is to include a privacy control function on the user's own device and to transform the recorded data to the extent that the user has no resistance to the automatic release of his/her life-log. Our answer to the second question is to employ the affordance theory in cognitive science. In this paper, we propose the design principle of establishing environmental simulation systems that use "human affordance" collected as user life-log. We envisage that combining life-log applications with a consideration of cognitive science will enhance life-log utilization.

M. Kurosu (Ed.): Human Centered Design, HCII 2011, LNCS 6776, pp. 235–242, 2011.

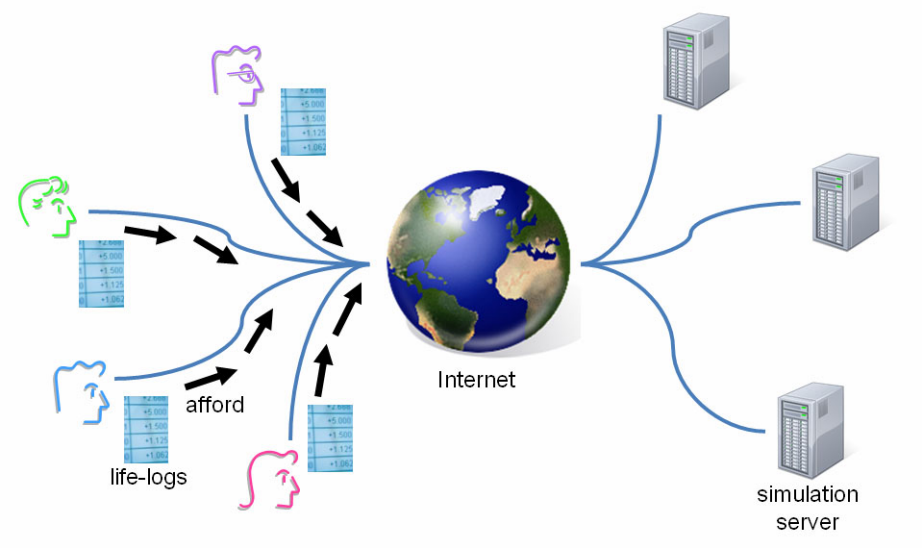

Fig. 1. A simulation system using life-logs from many users in the world

2 Research Background

Life-log technologies can be categorized into three types; collecting, processing and presenting. Sensors can be regarded as being covered by collecting technology. One example is logging the remote controller operations of an appliances [1]. Data mining for recommendation and user feedback interface are covered by processing and presenting technologies, respectively. The effective combination of those three life-log technologies is demonstrated by recent location-based services (LBS) using GPS (Global Positioning System) or Wi-Fi. In particular, a large amount of life-logs from people in many areas is regarded as collective intelligence and is being used for several kinds of simulation [2][7]. Many kinds of life-log will be used for LBSs in the future while identification number and position being the dominant data.

Environmental simulations play an important role in visualizing future problems with the earth and the attempt to find solutions. To raise the accuracy and effectiveness of the simulations, more simulation systems must process life-log data. Note that the same life-log data will be used by several simulation systems. For example, air conditioner logs can be used for both simulating the power consumption in a city and global warming. All such data can be collected and made accessible through the Internet. This means that it might be possible for future simulations to use real-time data collected from all over the world.

For future environmental simulations based on many kinds of life-log, this paper proposes the design principle of establishing environmental simulation systems that use "human affordance" collected as user life-log. We envisage that combining life-log applications with a consideration of cognitive science will yield better life-log utilization and that our design principle will stimulate the research field of human-computer interaction.

3 Problems with Life-Log Application

3.1 Continuous Life-Log Utilization

In order to continuously utilize the latest life-logs, we employ the "affordance" theory of cognitive science. In life-log-based simulations, there is a risk that user life-logs might not be sent or that their transmission will be intermittent. Ideally, life-logs should be sent to a server automatically but with the user's preferred exposure setting. To do this, we employ the affordance theory. For continuous life-log utilization, system design should not force users to perform additional operations to record logs.

3.2 User Resistance to Releasing Life-Logs

Users resist the release of their life-logs. A questionnaire answered by 1,104 experimental subjects revealed that 40% to 50% of them did not want to release their life-logs regardless of the kind; information search history, purchase history, geographical movement data etc. In order for users to accept the release of their activity data, their recorded life-logs should be stored on the user's own device such as a cell phone, and be sent to a server following commonly agreed principles. Another way to gain the user's acceptance of data release is log transformation. Transformation is needed because users are worried about sending negative data (such electricity use) to a third party such as a simulation system.

4 Proposed Design Principle

We propose the design principle of establishing environmental simulation systems that use "human affordance" collected as user life-log.

4.1 Affordance Theory

The term of affordance comes from the perceptual psychologist Gibson, who provided an ecological alternative to cognitive approaches[3][4]. His theory is that *the*

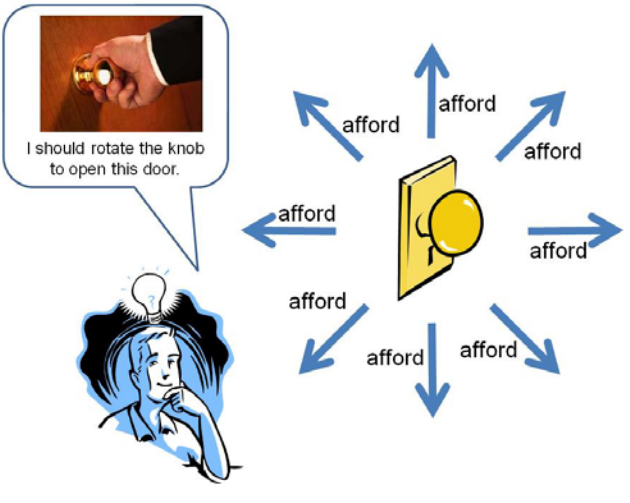

Fig. 2. Affordance theory: The attribute of the knob is afforded by its round shape

affordances of the environment are what it offers the animal, what it provides or furnishes, either for good or ill. The concept of affordance is popular in the field of user interface design as it provides a means of enhancing usability[6]. Fig. 2 shows the affordance of door knob. Human can understand how to operate it from its round shape.

4.2 Human Affordance

So as to utilize the cognition viewpoint for engineering, we extend the concept of affordance to cover human activities [5]. Human affordance is afforded from humans, not artifacts. In Gibson's affordance theory, information about an artifact is afforded to the ambient space through its "look" no matter whether a human perceives the artifact or not. As shown in Fig. 3, in the same way information about a human is afforded to the simulation server as the automatically gathered life-logs.

One advantage of human affordance is the focus it places on human factors, which will yield user-centered design of life-log-based simulation systems. Many kinds of simulations can be conducted anytime using desired data taken from the user life-logs. This is because many computers running simulation programs will be connected to the network and the life-logs collected from many users will always be ready to be used. This simulation flexibility in program choice, data range, and execution timing will lead to advanced simulations.

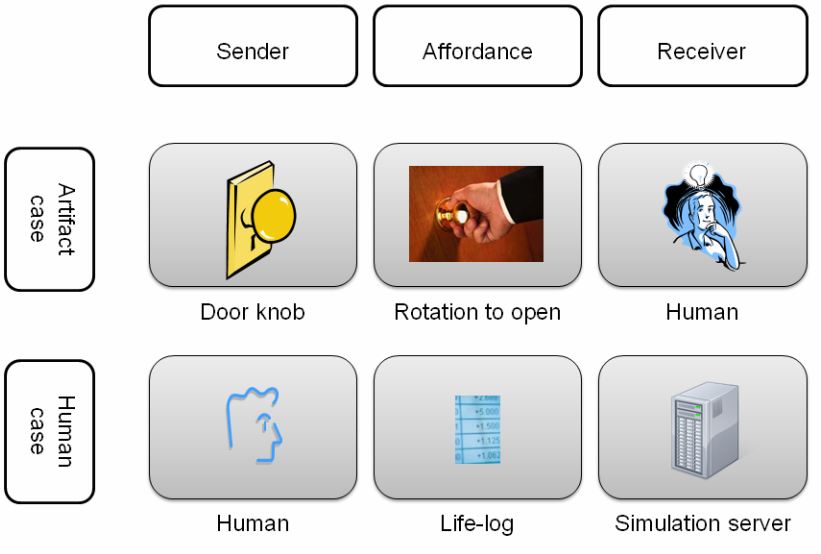

Fig. 3. A metaphor to understand human affordance

4.3 Encouraging the Release of Log Data

The underlying reason why users resist the exposure of their own life-logs is their fear of creating a negative impression. They do not want to afford information about their activities which would give others negative impression on themselves such as the

overuse of electricity data. This hesitancy can be overcome by transforming the data to eliminate the negative aspects. For example, if the user runs the air conditioner continuously for one month, the user's device sends only the average value of the other months. When the user alters the device usage pattern, switching the air conditioner off when not needed, the real air conditioner log is sent as environmental contribution data.

5 Experiments

We are investigating the degree of which life-logs should be transformed to create a positive feeling and thus secure release of the data. In this section, we introduce the experiments we conducted to examine user resistance to release of life-logs recorded on a cell phone device.

5.1 Experimental Design

The aim of this experiment is to determine the level of user resistance to transformed life-log data and to know what kind of logs trigger the strongest resistance. A questionnaire survey was conducted by 30 subjects in their 20s to 50s. We gave each subject the following instruction, question and answer choices.

Instruction:

Please assume that you live in a society where the logs on your cell phone such as device identification number, location and battery power were collected by a service provider for urban planning (i.e. environmental protection). Note that the device identification number will be used only for information feedback to you and is never used for any other objective.

Question:

How do you evaluate your resistance to the release of your logs in the following three exposure cases?

Exposure case:

A: Release as raw data with short cycle (e.g. every 5 seconds)
B: Release as raw data with long cycle (e.g. every 1 hour)
C: Release as transformed data with some cycle (e.g. every 5 minutes)

Answer:

1. *I agree because the release will lead to my convenience or contribute to society.*
2. *I accept if the released data will be kept anonymous.*
3. *I think that there is no choice though I am worried.*
4. *I do not want to release data.*

Note that the answer 4 indicates the highest level of resistance. The cell phone logs that subjects should evaluate in this experiment are a device identification number, location (latitude and longitude), whether talking on the phone or not, and battery level. Each subject was instructed additionally in the case of transformation (Case C).

The location is transformed to a name of city or town. Whether talking or not is transformed to a total time of talking. The battery level is transformed into the amount of change in battery level.

5.2 Results

The questionnaire results are shown in Fig. 4 to Fig. 7. The horizontal axis is the degree of transformation. The vertical axis is the percentage of subjects who responded with each resistance level.

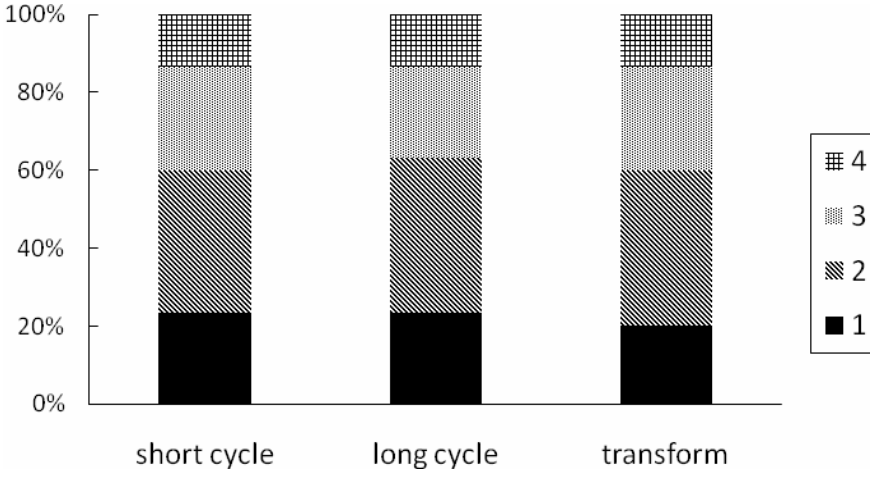

Fig. 4. Result for Device ID

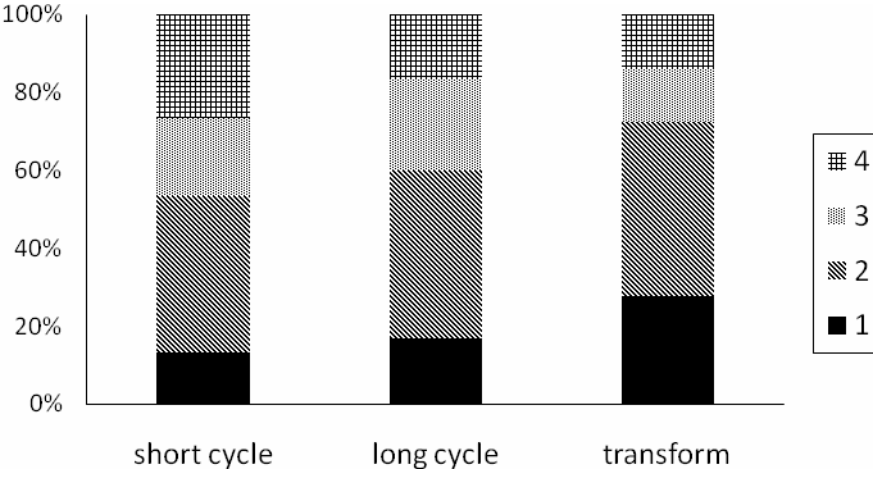

Fig. 5. Result for location

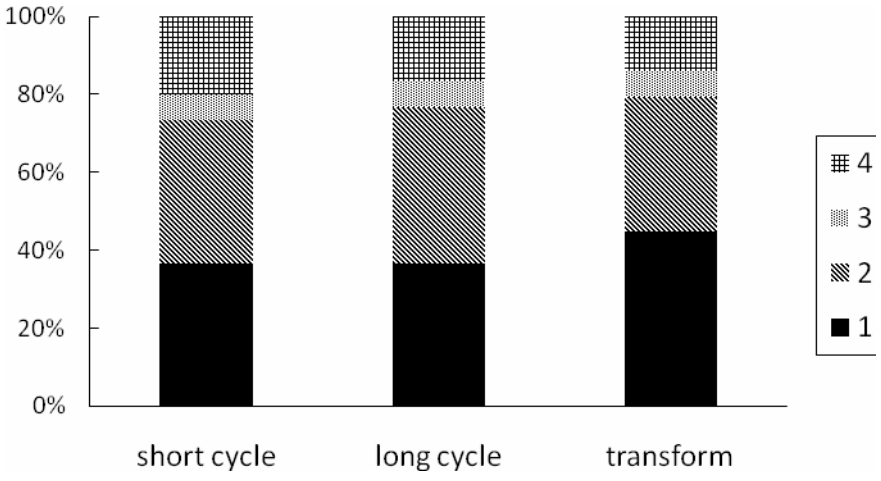

Fig. 6. Result for phone

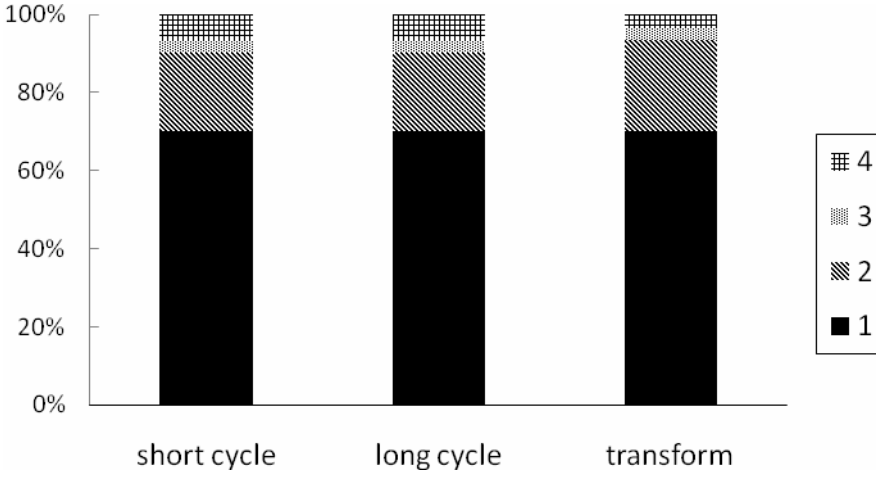

Fig. 7. Result for battery

6 Discussion

Figs. 4 to 7 prove that people strongly resist the release of location data and less concerned about battery data regardless of the level of transformation. As shown in Figs. 5 and 6, the level of resistance to the release of location data and phone use do not depend on the level of transformation. The decrease in resistance is not based on any specific transformation method but on the transformation concept itself. Future studies should examine specific transformation methods so as to eliminate negative factors in user life-logs and thus encourage user acceptance. For example, the

transformation that protects the environmental credentials of the user will be accepted because it provides the user with the impression of being a good steward of the environment. The first step is to encourage the acceptance of releasing life-logs. Such transformation will be more powerful when combined with sensing and information feedback technologies, for example, the EnergyLife [8] and the DEHEMS [9].

Another interesting point in this experiment is the low resistance to exposing the battery data (See Fig. 7). Although the amount of battery use on each cell phone device is very small, the total amount of batteries in use all over the world is too large to ignore. Given that the target of this study is the environmental simulation system of global scale, information about cell phone battery consumption is of significant interest.

7 Conclusion

This paper presented the design principle for establishing environmental simulation systems. We employed the concept of human affordance for continuous life-log utilization, and conducted a questionnaire survey to investigate the potential of life-log transformation in reducing the resistance of users to exposing their life-logs. Future work will include a study on effective life-log transformation methods and the development of an environmental simulation system that utilizes life-logs afforded from many users.

References

[1] Abe, M., Morinishi, Y., Maeda, A., Aoki, M., Inagaki, H.: A Life Log Collector Integrated with a Remote-Controller for Enabling User Centric Services. IEEE Transactions on Consumer Electronics 55(1), 295–302 (2009)
[2] Cuff, D., Hansen, M., Kang, J.: Urban Sensing: Out of the Woods. Communications of the ACM 51(3), 24–33 (2008)
[3] Gibson, J.: The Senses Considered as Perceptual Systems. Allen and Unwin, Ltd., London (1966)
[4] Gibson, J.: The Ecological Approach to Visual Perception. Houghton Mifflin, New York (1979)
[5] Ihara, M., Kobayashi, M., Sakai, Y.: Human Affordance. International Journal of Web Based Communities 5(2), 255–272 (2009)
[6] Norman, D.A.: The Psychology of Everyday Things. Basic Books, New York (1988)
[7] PlaceEngine, http://www.placeengine.com/
[8] Jacucci, G., Spagnolli, A., Gamberini, L., Chalambalakis, A., Björksog, C., Bertoncini, M., Torstensson, C., Monti, P.: Designing Effective feedback of Electricity Consumption for Mobile User Interfaces. PsychNology Journal 7(3), 265–289 (2009)
[9] Sundramoorthy, V., Liu, Q., Cooper, G., Linge, N., Cooper, J.: DEHEMS: A user-driven domestic energy monitoring system. In: Internet of Things 2010 Conference, pp. 1–8 (2010)