Introducing Gamification to Cleaning and Housekeeping Work

Satoshi Ichimura[(✉)]

Information Design Course, School of Social Information Studies,
Otsuma Women's University, Karakida 2-7-1, Tama, Tokyo 206-8540, Japan
`ichimura@otsuma.ac.jp`

Abstract. Gamification is the concept that utilizing elements and ideas of video games in non-gaming fields. It aims at improving user experience, user engagement and users' motivation by utilizing elements and mechanisms by which video games entertain many people. In the paper, we explain some basic ideas to let people enjoy housekeeping work, and propose a vacuum cleaner with gamification elements as an example of the ideas. As a result of the experiments, it turned out that our vacuum cleaner with game elements could provide more enjoyable experience to users than usual.

Keywords: Gamification · Cleaning · Housekeeping · Vacuum cleaner

1 Introduction

Although household chores as typified by cleaning must be repeatedly done every day, sustaining the motivation to do them is not easy for many people. Therefore, we thought that it is important to improve the motivation of doing housekeeping, and came up with an idea to introduce gamification elements to housekeeping.

Gamification is the concept of applying game mechanics and game design techniques to fields other than games. It aims at improving user experience, user engagement and users' motivation by utilizing game elements and mechanisms that attract a number of people.

Game elements include mechanisms to visualize the results that the user achieved through the use of ranking, scoring or giving a badge. It becomes easier to understand how hard he/she tried or how much his/her progress is being achieved. Furthermore, merging SNS mechanisms to gamification has a possibility to provide pleasure of collaboration or competition with friends having the same purpose, so that it could increase users' motivation more.

In this paper, we propose a vacuum cleaner with gamification elements. The vacuum cleaner has an acceleration sensor, and is capable of detecting the movement of cleaning behavior. As a result of the experiments, it turned out that our vacuum cleaner with game mechanisms could provide more enjoyable experience to users than usual.

2   Backgrounds

During recent years "gamification" has gained significant attention. It is an idea to apply elements and ideas, that attract many gamers, of video games to non-gaming fields. Gamification is also said to be good at maintaining motivation and preventing getting bored.

As elements to improve motivation, Scientific American [10] claimed the following three points:

1. Autonomy: People can strive if they feel that "they are responsible and actively doing things, not being forced to do them".
2. Value: Motivation is improved if people can find value in goals. If they can recognize that the goal is important, they are likely to make effort.
3. Competence: The more you improve, the more your motivation increases.

Kishimoto [7] claimed the following points are important to design attactive computer games.

1. Immediate feedback: It is important in game design to immediately return the responses to user actions. If the reaction is slow, the user can not enjoy the game itself.
2. Growth visualization: Indicates the growth of the character self-projected by the user. The user gets into the game when he/she wants to see their growth.
3. Achievable goal: If a difficult goal is imposed in the early stages, the user stops the game before feeling fun. Give users a small sense of accomplishment frequently.

Many games have elements that improve users' motivation as mentioned above. Gamification aims to utilize these elements to revitalize the behavior of daily life.

3   Related Work

Here we describe examples of gamification where the game is applied to solve problems that happens in daily life.

Nike + Running [4] is a smartphone application that calculates mileage and calorie consumption. GPS in the smartphone is used. The level is judged according to the running distance, and the level is visualized by color. The color level starts from yellow, goes through orange, green, blue and goes black. When the running situation is published to Facebook, and "Like" arrives from a friend, cheering voice is emitted during running.

Foursquare [1] is a smartphone application that automatically records shops and facilities visited by users. GPS in the smartphone is used. Users can earn points by "checking in" to the places, and earn badges such as Mayor (mayor) of that place when checking more than predetermined number of times. Users can compete with their friends.

Ingress [2] is also a smartphone application that makes walking activity a funny game. A user can acquire a base (portal) that is located all over the world by vising the location, and get the area as his/her territory. The portal is often located near famous historical sites or art work, so that a user can enjoy regional sightseeing at the same time.

Studyplus [5] is a learning management SNS integrated with gaming mechanisms to promote continuation of learning. When the user inputs the progress of the day into the site, the progress is visualized as a graph. In addition, users can compete with a number of anonymous friends having the same goal.

Microsoft [6] introduced gamification called "language quality game" to the development process of Windows multilingual version. During localization, correcting misunderstanding of languages requires a tremendous amount of work, so it was a problem that the motivation of debugging staffs gradually declined. In the language quality game, Microsoft employees around the world were asked to find suspicious word. Every time they find a suspicious word, they get a point. Based on that point, ranking was announced to maintain motivation. It was reported that more than 7000 suspicious word had been discovered.

Hashiguchi et al. [8] proposes an application with a gamification mechanism to correct irregular sleeping time in college life. As a result of comparing the application with and without gamification function, it turned out that users of the application with gamification function had been able to use the application longer.
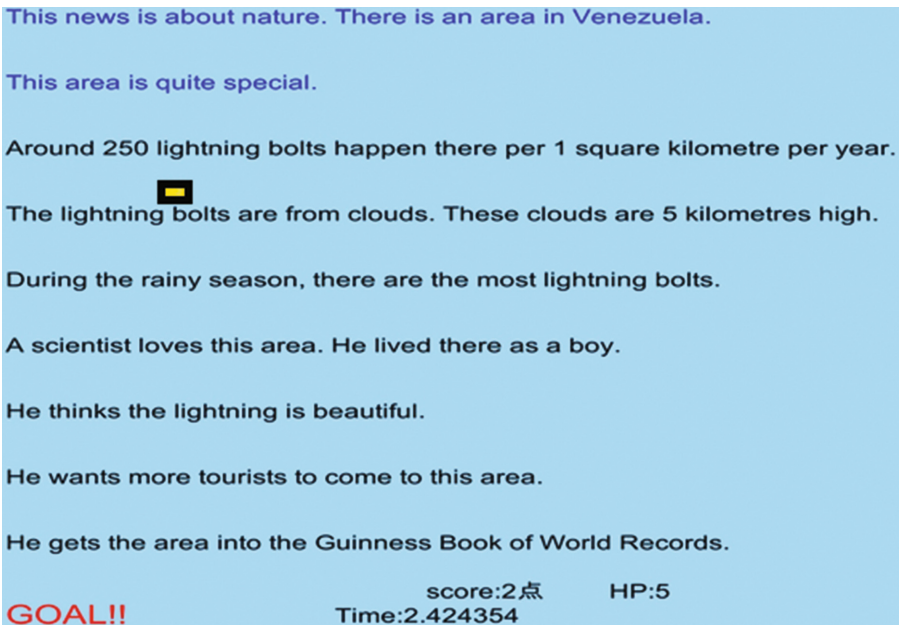

This news is about nature. There is an area in Venezuela.

This area is quite special.

Around 250 lightning bolts happen there per 1 square kilometre per year.

The lightning bolts are from clouds. These clouds are 5 kilometres high.

During the rainy season, there are the most lightning bolts.

A scientist loves this area. He lived there as a boy.

He thinks the lightning is beautiful.

He wants more tourists to come to this area.

He gets the area into the Guinness Book of World Records.

score:2点   HP:5
GOAL!!   Time:2.424354

Fig. 1. English reading game.

We have conducted research on how to utilize the effect of gamification since several years ago, and we developed a PC game called "English reading game" (Fig. 1). The application constantly monitors the movement of the user's eye using an eye tracker Tobii EyeX Controller [9]. The color of letters that a user has seen changes. A high score is given when the eye moves in the order in which the English sentences are written, and a low score is given when the user read the same sentence more than once. Various badges are given depending on the score, and also the level is determined by the score.

In order to examine the usefulness of gamification function, we conducted an experiment to compare different versions with and without the gamification mechanism mentioned above. As a result of the evaluation, the motivation of reading the English sentence was higher in the version with the gamification element.

4   System Design and Implementation

4.1   System Design

We conducted research on how to utilize the effect of gamification since several years ago. In this paper, we propose a vacuum cleaner that can make cleaning work fun. A typical user might be a person who thinks cleaning is troublesome, or who cannot maintain his/her motivation for cleaning.

There is no vacuum cleaner equipped with the gamification function in the market so far. Development of Conventional vacuum cleaners has been aiming only for performance improvement such as suction power, silence, power saving, etc. As far as we know, vacuum cleaners have not been developed from the viewpoint of making housework fun. We think it is necessary to support housekeeping work from such a new viewpoint.

Our a vacuum cleaner has following unique functions:

1. Score acquisition: The device detects the motion of the vacuum cleaner and calculates its score, whereas score is high when the speed of the movement is appropriate. Score is determined from 1 point to 5 point according to the movement.
2. Game sound generation: Different sound is generated depending on the acquired score. A user can know how good the movement of the vacuum cleaner was by listening to the sound.
3. Twitter submission: When a user starts cleaning, the system submits a tweet to Twitter, and lets his/her friends know he/she starts cleaning. In addition, if the tweet is retweeted or replied by someone, a cheering message is displayed in the user's PC screen and a funny sound is generated.

A device capable of measuring triaxle acceleration is attached to the vacuum cleaner (Fig. 2). The device attached to the vacuum cleaner transmits the detected motion to a PC for processing via XBee wireless [11], and the PC analyzes the motion.
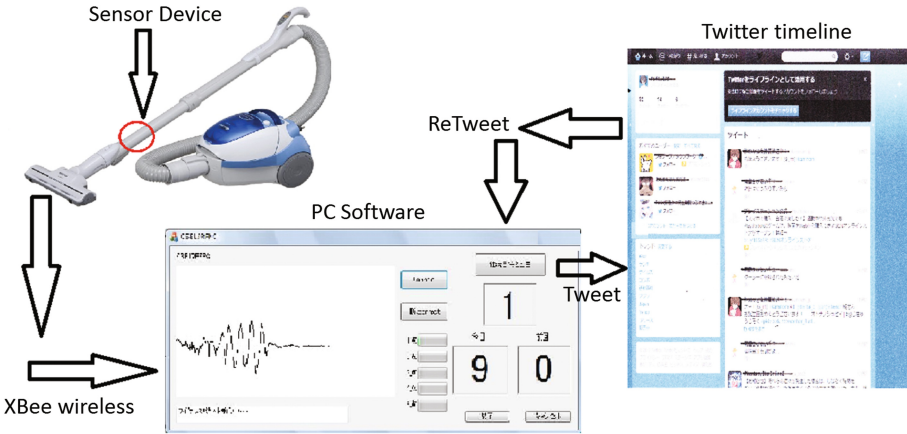
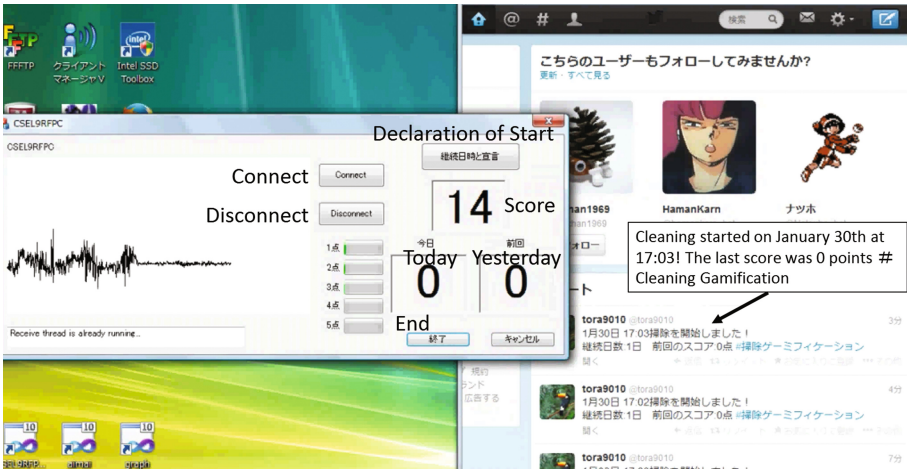**Fig. 2.** System architecture.

Fig. 3. PC software.

When a user starts cleaning, he/she presses the "Declaration of Start" button and logs in to Twitter account, then a tweet like "Cleaning started on January 30th at 17:03! The yesterday's score was 120 points # Cleaning Gamification" is posted in the Twitter timeline. When "End" button is pressed, today's score is recorded (See Fig. 3).

4.2   System Implementation

This system consists of a device attached to the vacuum cleaner (Fig. 4) and PC software (Fig. 3)running on the PC. The device attached to the vacuum cleaner detects the reciprocating motion of the vacuum cleaner with built-in
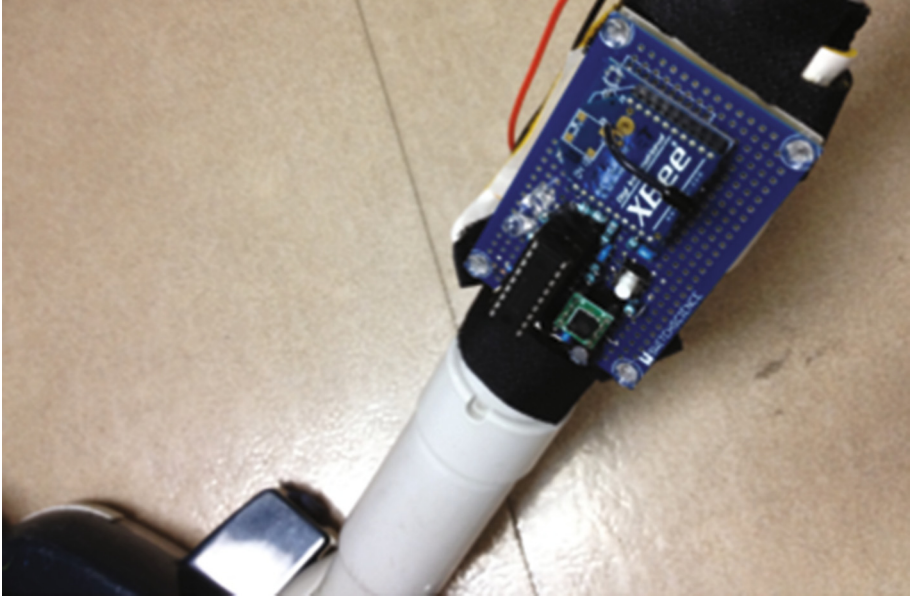
Fig. 4. Sensor device.

acceleration sensor and transmits the motion value to the PC. The software on the PC analyzes the reciprocating motion transmitted from the device, calculates game score.

Device Attached to the Vacuum Cleaner. Three axis acceleration sensor, KXM 52-1050 of KYONIX Corporation, to acquire reciprocating motion is built in the device. This sensor is capable of measuring XYZ-axes acceleration in a range of ±2G. An 8-bit microprocessor PIC16LF88, which is often used in small built-in computer systems due to features such as low power consumption, is embedded in the sensor.

Figure 4 shows how the sensor device attached to the vacuum cleaner. The program that controls the device attached to the vacuum cleaner is written in assembler. Through this program, the 3-axis acceleration data are transmitted to the PC. For wireless communication between the PC and the device, XBee module [11] is used. XBee's wireless reaches about 30 m indoors.

PC Software. Software running on the PC processes reciprocating motion data transmitted from the device attached to the vacuum cleaner via XBee, and calculates game score, etc. Software is mostly implemented in C++, and Twitter linkage part is written using Java Twitter4J library [12].

Software has functions to display the waveform of 3-axis acceleration data from the sensor device, calculate game score and also post tweets to Twitter when a user starts cleaning or tweet is retweeted or replied by someone.

The usage of software is explained using Fig. 3.

By pressing the "Connect" button, a communication between PC software and the device attached to the vacuum cleaner starts, and the waveform of 3-axis acceleration data is displayed in the left figure. At the same time, software automatically posts a tweet, like "Cleaning started on January 30th at 17:03", to Twitter.

The numbers under the text "Today" and "Yesterday" in the middle of the figure are today's high score and last high score, respectively. Also, the number under the text "Declaration of Start" is the current total score. The bar to the right of "1 point" to "5 points" indicates the number of each point that the user acquired. When the "End" button is pressed, the score of today and the score of yesterday are recorded and software program ends.

The score is designed to be high when the speed of the cleaning movement is appropriate. Score is determined from 1 point to 5 point according to the movement, and a sound corresponding to the acquired score is emitted from the PC speaker. Also, during cleaning, if the tweet posted by software is retweeted or replied by someone, a cheering message is displayed in the user's PC screen and a cheering sound is generated.

The updateStatus method and getRetweetCount method of the Twitter 4 J library are used to post a tweet and acquire retweets and replies. Software is designed to execute these methods at intervals of 5 seconds or more because Twitter API does not allow applications to issue more than 180 requests per 15 min.

5   Evaluations

We conducted experiments in order to verify the effectiveness of the proposed system.

5.1   Experiment 1

The subjects, eight males and two females in the early twenties, were asked to clean rooms for five minutes through the use of a vacuum cleaner with gamification device, and were required to answer some questionnaire. To the question "Was it fun to clean a room?", the subjects answered in 5 grades of 5:strongly yes, 4:yes, 3:yes/no, 2:no, 1:strongly no.

As the result, the average score was 4.5, indicating that the satisfaction level was high.

We also conducted experiments to compare our system and Twitter standard client. The same subjects, eight males and two females in the early twenties, were asked to use Twitter official client and enter some comments when they start and end cleaning. To the question "Was it fun to clean a room?", the subjects answered in 5 grades of 5:strongly yes, 4:yes, 3:yes/no, 2:no, 1:strongly no.

As the result, the average score was 2.1. This result indicates our system appears to get a higher satisfaction than Twitter client.

5.2 Experiment 2

Next two experiments were conducted to compare whether each function provided by this system was valid or not.

First, the function to generate game sound was tested. Our device detects the motion of the vacuum cleaner and calculates its score, and game sound is generated depending on the acquired score. To the question "Was it fun to clean a room?", the subjects answered in 5 grades of 5:strongly yes, 4:yes, 3:yes/no, 2:no, 1:strongly no. Subjects were the same eight males and two females.

As the result, the average score was 4.3 when the sound generation function was used, and 3.4 when the sound generation function was not used.

Second, Twitter submission function was tested. When a user starts cleaning, the system submits a tweet to Twitter, and if the tweet is retweeted or replied by someone, a cheering message is displayed in the user's PC screen and a funny sound is generated. To the question "Was it fun to clean a room?", the subjects answered in 5 grades of 5:strongly yes, 4:yes, 3:yes/no, 2:no, 1:strongly no. Subjects were the same eight males and two females.

As the result, the average score was 3.5 when the Twitter submission function was used, and 2.8 when the Twitter submission was not used.

Above results indicate certain effects are recognized for both the sound generation function and Twitter submission function. Both functions indicated that cleaning became fun by adding gaming elements. It turned out that the purpose of this research was achieved.

6 Conclusions

In this paper, we explained the outline of gamification, and also described our sample application to gamify household chores.

We would like to build a mechanism on the SNS that encourages competition compared with others and a mechanism to give pleasure that everyone is enjoying it. In addition, if a location sensor that detects the cleaning place can be installed to the device, for example, an enjoyable treasure hunting game may be implemented.

We would also like to support not only cleaning but also other tasks, like gardening, toothbrushing, make-up and other activities at home.

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