Micro-Crowdfunding: Achieving a Sustainable Society through Economic and Social Incentives in Micro-Level Crowdfunding

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ABSTRACT

This paper introduces a new approach, named micro-crowdfunding, for motivating people to participate in achieving a sustainable society. Increasing people’s awareness of how they participate in maintaining the sustainability of common resources, such as public sinks, toilets, shelves, and office areas, is central to achieving a sustainable society. Micro-crowdfunding, as proposed in the paper, is a new type of community-based crowdsourcing architecture that is based on the crowdfunding concept and uses the local currency idea as a tool for encouraging people who live in urban environments to increase their awareness of how important it is to sustain small, common resources through their minimum efforts. Because our approach is lightweight and uses a mobile phone, people can participate in micro-crowdfunding activities with little effort anytime and anywhere.

We present the basic concept of micro-crowdfunding and a prototype system. We also describe our experimental results, which show how economic and social factors are effective in facilitating micro-crowdfunding. Our results show that micro-crowdfunding increases the awareness about social sustainability.

Categories and Subject Descriptors
H.5.m [Information interfaces and presentation]: General

General Terms
Design; Human Factor.

Keywords
Crowdfunding; Crowdsourcing; Local Currency; Virtual Economy; Community; Internet of Things; Social Media; Sustainability; Mechanism Design.

1. INTRODUCTION

Free resources that are shared by a number of people, such as public toilets or the natural environment, tend to be overused as a consequence of the tragedy of the commons [15]. This problem occurs because each individual derives a personal benefit from using the resource, whereas any costs are shared among all of the users; this circumstance then leads to inconsiderate use. An example of such behavior is the wasteful use of free plastic shopping bags, which are filling landfills. A common strategy for addressing the tragedy of commons is to impose a tax on the use of the resource. An environmental tax can be widely adopted for covering the cost of maintaining the resources. However, for taxpayers, it is not clear how the tax is used for maintaining each common resource that is shared by the members of the community. People must experience a feeling of having contributed to the sustainability of the resource to be motivated to pay the necessary cost.

A community-based approach overcomes this issue. With such an approach, a community member can propose a mission for maintaining the community’s sustainability, and other members of the community can then complete the mission. However, members usually do not have enough time to contribute to a mission. In particular, people who live in urban areas are very busy and have large numbers of commitments. Therefore, they usually forget the importance of sustainability in our society. In our daily environments, we have numerous small, common resources that require a high cost for maintenance if the government, nonprofit organizations and individual companies take care of them. However, maintaining these resources typically necessitates missions that can be achieved with a small amount of effort in a person's spare time. In our urban lives, we usually have plenty of opportunities to take advantage of small amounts of spare time.

This paper proposes a new approach, named micro-crowdfunding, for increasing people’s awareness of the importance of sustaining our society and for motivating people in urban areas to participate in achieving a sustainable society. Micro-crowdfunding is a new community-based crowdsourcing architecture [19, 20]. In traditional community-based crowdsourcing systems, completing micro tasks is motivated through the use of social incentives, then individuals complete the tasks through their own spirit of reciprocity for strangers. This incentive is not strong enough to complete the micro tasks referenced in micro-crowdfunding. In micro-crowdfunding, completing micro tasks is motivated within a community whose members are known to each other. An economic incentive is also used to motivate the community members to complete the tasks, but the incentive is not in the form of a monetary reward. Instead, micro-crowdfunding increases people’s awareness of the meaning behind completing micro tasks, thereby increasing their intrinsic motivation to complete the tasks. Using mobile phones is also a key factor in lowering the hurdle for contributing to the community. Its members increase their activities in the face of smaller incentives because activities can be performed anytime and anywhere in mobile community-based crowdsourcing, as shown in [19, 20].

The main characteristics of the approach are as follows:
• The crowdfunding concept is adopted to allow people to choose among the small, common resources to which they would like to contribute in order to maintain their sustainability;
• The currency used in the proposed approach is based on the aging-money concept [31], which encourages people to participate in micro-crowdfunding before the money’s value is degraded;
• The interaction in micro-crowdfunding is very lightweight. People in a community can easily propose new micro-tasks, called micro-missions, in micro-crowdfunding and fund them from their smart phones through a simple interaction; and
• The participants can share information and details about a micro-mission and receive appropriate feedback for the activities that they perform.

The micro-mission in micro-crowdfunding can be achieved with minimal effort by individuals in their spare time. Additionally, it provides community members with some economic and social incentives. Micro-crowdfunding includes a mechanism through which participants receive an amount of virtual currency as a reward. This mechanism offers the participants an economic incentive. Additionally, cooperation within a community provides a social incentive.

The paper is organized as follows. In Section 2, the paper presents some related research. Section 3 presents the micro-crowdfunding concept, and Section 4 shows the experimental results of a micro-crowdfunding prototype system. Section 5 discusses several issues in the current design of micro-crowdfunding. Finally, Section 6 concludes the paper and presents future directions for study.

2. RELATED WORK

Although several research works have already investigated existing crowdfunding infrastructures [10, 13, 14, 16], very little research has been devoted toward the design and experience of building new crowdfunding infrastructures. In spite of this dearth of research, [21] provided an experiment in enterprise crowdfunding as a useful example. Employees allocated money for employee-initiated proposals in an enterprise Intranet site, including a medium-sized trial of the system in a large multinational company. The results showed that communities in a large company propose ideas, participate and collaborate and that their activities can be encouraged through crowdfunding. The approach details a new collaboration opportunity and shows that crowdfunding is a promising method for increasing activity within communities.

“Local currency” refers to complementary currency used only in a defined region as an alternative to the national currency. Aging money is a typical currency system in which local currency is used. People use local currencies only within a region for local and small-scale money circulation, where the currency can be used as payment in a local shopping area or as a token of gratitude for volunteer work. Local currencies have been drawing attention as a means to reactivate a community or stimulate a regional economy. In Japan, specifically, the NHK satellite television broadcast of “Michael Ende’s Last Message: Questioning Money from Its Roots” and the book published on the TV program [45] became a catalyst for local currency efforts, and the broadcast and the book had a substantial influence on a large number of regional Japanese communities. In Japan, more than 660 local currencies currently exist (2011.1.6), including a currency named “Rate” [43], issued by Sanjo City in Niigata Prefecture. ‘r’ [42] is a local currency used around the Shibuya region in Tokyo, issued by Earth Day Money Association, and it has further spread from that region. Also, outside of Japan, there are well-known local currencies, such as Ithaca HOURS [39], used in Ithaca, New York State, USA, and LETS (Local Exchange Trading System) [41], which began in Canada and has spread to other countries, such as the United Kingdom and Australia.

The basic mechanism of crowdfunding is similar to the mechanism of crowdsourcing. Amazon Mechanical Turk is currently the best known crowdsourcing system [35]. Amazon Mechanical Turk uses monetary rewards to encourage people to work on micro tasks. This means that the system only takes into account the economic incentive. However, as shown in [1, 2], monetary rewards are not always the best way to motivate contributing users. Instead, contributors appreciate many intangible factors, such as community cooperation, learning new ideas and having entertainment. In [19], Liu et al. also showed that their crowdsourcing system, named MoboQ, works well without monetary rewards. Gamification [34] has recently become a popular concept for making daily and business activities more enjoyable. Its basic idea is to use a subset of game mechanisms, such as points, leader boards and badges, to control human activities in daily life and business. However, as shown in [20], gamifying crowdsourcing services may not work well because game mechanics, such as points and badges, are not sufficient to encourage people to increase their target activities. Because ideological incentives are essential factors in increasing people’s intrinsic motivation, as shown in [27, 28], many successful games offer ideological incentives with well-designed psychological incentives that stimulate people’s emotions effectively.

EcoIsland is one of these persuasive ambient mirrors [23], and a study of it illuminated its motivational factors, such as social and economic incentives. The system was developed as a desktop application or a mobile phone application that expresses a representation of a family on a virtual island. The users set a target CO2 emission level; they manually report their consumption levels using the desktop or the mobile application. If they fail to stay below the consumption limit, the level of water around the island rises. This consequence makes the avatars living on the island feel threatened. To reduce the level of water, several tasks are proposed. These actions can include energy reduction in the house, such as unplugging some devices, or outside the house, such as using public transportation instead of a car. They also earn virtual money, which they can exchange online with other families who did not reach the target level of emissions, or they can buy items to decorate their island.

Mona Lisa Bookshelf is aimed at keeping a bookshelf organized [23]. It tries to encourage users not only to keep books in order and to return missing books but also to take books out every now and then for reading. Each book in the shelf is linked with a piece of a digital image of the Mona Lisa. As in a picture puzzle, the image changes according to how the books are positioned. A high-quality, flat display placed near the bookshelf shows the image to the users. Mona Lisa Bookshelf adopts a game mechanism that offers a psychological incentive to the user. It controls the user’s sustainable behavior through feedback control, with positive and negative feedback.

A community-based crowdsourcing approach [19, 20] is important in designing a future infrastructure for social media. This approach allows us to enhance existing social media by leveraging end-users. Participants are very significant for the evolution of social media. The personality analysis framework [29] is essential for analyzing end-users’ participation because people who have different personalities have different reasons for participating in social media. When designing a community-based
crowdsourcing system, the user’s motivation is a key issue, and people who have different personalities should enjoy participating in a community for crowdsourcing.

A wide range of studies have been published that connect questions of environmental sustainability and ecological responsibility to topics in HCI. DiSalvo et al. [7] present a comprehensive review of this research. They note a broad focus on individual rather than collective actions, on information technology as a persuasive force in attitude and behavior change, and on the adoption of existing HCI methods, tools, and theories as a means to a solution. Specifically, they note a shortage of papers that conceive of environmental sustainability as a problem that has a significant political aspect.

Micro-payments have been used in a variety of e-commerce services. First, they were introduced as a potential method for measuring web content usage through users paying for page visits to a site [11]. Recently, micro-payments have become a popular transaction mechanism for buying music and applications [25]. They have also played an important role in controlling “free-riders” in peer-to-peer systems by charging individuals for downloads and replenishing credit based on sharing habits [12]. Finally, micro-payments have been explored as a method for altering consumer behavior, aiming to improve sustainable habits [33].

3. MICRO-CROWDFUNDING CONCEPT

3.1 Basic Concept

Crowdfunding is a new and emerging way of funding new ideas or projects by borrowing funding from the crowd [10]. In this approach, a person proposes a new project, explains its importance, provides the target amount of money, and shows what people who fund the project will receive when the mission is completed successfully. When the total amount of funds from people who would like to contribute to the project exceeds the target amount, the project can be started. After the success of the project, each contributor receives some benefits according to his or her funding. This approach is different from a donation because contributors will expect some benefit when the supported project succeeds, whereas a donation does not include any return considerations. If the benefit has a high scarcity value, it provides a great incentive for the contributors. However, existing crowdfunding platforms, such as Kickstarter [40], Indiegogo [38], RocketHub [44], Fundable [37], and CrowdFunder [36] require participants to fund with real money; thus, only people who have extra money can join in. Additionally, it requires much more effort to execute a project because the scale of a project tends to be large.

In micro-crowdfunding, we aim to provide an opportunity to everyone who wishes to contribute and take part in making our world better. The project in this service is called a micro-mission because it requires only a small amount of time to be completed and because it attempts to achieve the sustainability of a small, common resource in a person’s spare time with minimum effort.

Instead of using real money, micro-crowdfunding adopts a special mechanism, called the local currency, from an economic perspective. A local currency is a currency that is not backed by a national government and is intended to be traded only in a small regional area. As a tool of fiscal localism, local money can raise awareness of the local economy. One of the most important aspects of the local currency is the possibility of adopting different money models, which cannot be adopted by their legal tender. For example, the aging money model [31] has been a popular example of the local currency idea. Aging money has been widely used to encourage monetary circulation within a community because people do not want to save their money for their future. Thus, aging money is very effective in increasing a community’s economic activity. In the aging money concept, the value of money gradually decreases with time. Defining a suitable money model is desirable when it is essential to encourage people to spend more money. Because our approach relies on the aging money concept, it is natural that people would like to contribute to more micro-missions before the value of the money is degraded; thus, they must fund micro-missions as quickly as possible. To encourage community members to contribute to a micro-mission, we set the rule that the value does not degrade when a person funds his or her money. When a micro-mission is completed, half of the money funded to the micro-mission is returned back as a reward to him or her. This arrangement is an incentive and motivates participants to fund more micro-missions. Because the proposed micro-crowdfunding concept uses virtual currency, all of the transactions occur electronically.

![Figure 1. Tax-based vs. Crowdfunding-based Approaches](image)

The environmental tax is the most typical solution for achieving the sustainability of common resources. The money collected as tax can be used to maintain the resource’s sustainability. However, taxpayers are not aware of how the money is spent to contribute to sustainability, as shown on the left side of Figure 1. In micro-crowdfunding, as shown on the right, people can explicitly choose to which common resource they would like to contribute. This approach increases awareness of their contribution because the effect of their contribution can be easily monitored. After the micro-mission to which the participants are contributing has been completed, each participant who has funded it receives a completion of notification as feedback. The awareness of their contribution becomes a strong incentive for people to contribute to the sustainability of the common resource.

![Figure 2. Overview of Micro-crowdfunding](image)
In micro-crowdfunding, as shown in Figure 2, a member of a community related to a small, common resource, called a mission organizer, proposes a new micro-mission when he or she is aware that an activity must be completed to maintain the sustainability of the resource. Typical examples of such common resources are a public sink in a building or a public shelf used by a university laboratory. The proposal includes the micro-mission’s summary, which specifies the necessary activities and the total amount of money required to achieve the micro-mission. The micro-mission proposal is performed simply by touching the common resource with the mission organizer’s smart phone and sending a photo that shows the resource’s current status.

In the next step, when some other members, called mission investors, receive requests to fund the mission, they decide whether they want to fund the micro-mission based on the delivered photo. If some of them would like to fund the mission, then they simply click on the request on their phones to notify that they want to fund the micro-mission. When the total submitted funds exceed the target amount, the micro-mission can be executed by any member who can access the resource in his or her spare time. Such a member is called a mission performer. The mission is usually a very simple task, such as cleaning up a public sink or organizing a shelf. After completion, the mission performer takes a photo of the resource to show the micro-mission’s completed status and sends it to the mission organizer. Finally, the mission organizer verifies the quality of the achievement, and a completion notification of the micro-mission, which contains a photo of the resource, is delivered to all of the members who funded the mission.

3.2 Social Incentives and Economic Incentives

In [23], Nakajima and Lehdonvirta propose five incentives that are useful in designing information services to encourage people’s activity towards desirable lifestyles. The five incentives include physical incentives, psychological incentives, social incentives, economic incentives, and ideological incentives. Psychological incentives have been widely used in various information services, and the game mechanisms in gamification are popular and useful tools in designing psychological incentives. Physical incentives have been used to make virtual objects tangible, and ideological incentives have been used with virtual objects to increase people’s intrinsic motivation. Psychological incentives become more effective when used in conjunction with ideological incentives [28]. We consider how to use these three incentives in micro-crowdfunding systems in future research.

Social and economic incentives are especially important in designing social media-like crowdsourcing and crowdfunding systems because economic incentives are widely used with monetary rewards, and social incentives are key factors in making social media successful. For designing the micro-crowdfunding system, we especially focus on these two incentives for activating members within each community.

This section presents an overview of the social and economic incentives that are used as mechanisms to encourage community members to more actively participate in micro-crowdfunding.

A set of strategies for persuading users can be found in the literature on social psychology and sociology. Being social animals, humans react to the actions, expressions, and the mere presence of other humans. Two concrete strategies explored in our case studies are social facilitation and conforming behavior [9]. Social facilitation refers to the phenomenon in which people perform better at a task when someone else, such as a colleague or a supervisor, is watching. This circumstance applies to simple tasks that are easy for the subject; in complex tasks, performance might suffer instead.

Not surprisingly, we also found that using economic incentives is a powerful technique for motivating people to change their behavior. An economic incentive is a tangible reward that users consider to be valuable; however, the reward is not necessarily actual money or goods. In online games, millions of players work hard to obtain rare and valuable virtual goods and even trade those goods for real money at a rate of $3 billion per year [17]. Another example of economic incentives in persuasive technology is an activity-based billing system [33], which uses automatic micropayments and micro rewards to coax users toward desired behaviors. Although economic incentives are a powerful tool to motivate behavior, they can lead to unpredictable results if they are not used carefully [18].

The micro-crowdfunding system uses both social incentives and economic incentives. In this system, because the virtual currency is explicitly used as local currency to stimulate a community, the role of economic incentives is obvious. However, the role of social incentives in micro-crowdfunding is not clear at the moment. As shown in [1, 2], economic incentives, such as monetary rewards, do not work well in isolation for achieving social sustainability; increasing people’s intrinsic motivation is more important. Social incentives make it possible to increase awareness of the importance of users’ participation to achieve social sustainability, and their intrinsic motivation is increased. Therefore, the balance of economic and social incentives is the most essential design factor in making micro-crowdfunding more successful. The experiment described in the paper offers useful insights to improve the current design of social media that use social and economic incentives.

3.3 User-Centered, Scenario-Based Designs

This section presents how each stakeholder in micro-crowdfunding experiences his or her participation and contribution to a mission from the user’s point of view through an example scenario shown in the storyboards in Figures 3 and 4.

(1) Jun is a university student who is currently very busy with his research, and he must go to his laboratory every day. He is worried about the use of some small, common resources in his laboratory. In particular, he is bothered by a messy table there. He wants to use the table, but he currently has no time to clean it up because of his busy schedule. “It would be great if someone could help me,” he thinks.

(2) Next, he decides to create a micro-mission with the title, “Please clean this table” and he makes an appeal for collecting funds from people who use the same table. He takes a picture of the dirty table with his smart phone to inform others of its status. Somewhat later, when he has spare time, he sets the requisite amount of money to 10 bells, where a bell is the unit of the virtual currency used in the micro-crowdfunding service, and he provides 3 bells himself as an initial fund of the micro-mission using his smart phone.

(3) Kazuya, Aki and Haruka are Jun’s colleagues in the laboratory. They all receive the proposal about the micro-mission through an email delivered due to Jun’s micro-mission registration. Kazuya agrees with Jun that the table needs to be cleaned. Thus, he funds 3 bells to the micro-mission’s fund with his smart phone. The total amount of money becomes 6 bells.
Kazuya often uses the table as well, and he very much wants the micro-mission to be achieved.

Figure 3: Storyboards in An Example Scenario (1)

(4) Aki and Haruka are together when they receive the proposal. As soon as they receive the email, Aki says, “I feel that it is a good idea for our laboratory members. I want to join the micro-mission.” Haruka also agrees; then, each of them funds 2 bells with their smartphones. The total amount of money reaches 10 bells, which is the target amount that Jun has chosen. As a result, the micro-mission “Please clean this table” becomes executable, and all of the participants are informed about that status.

(5) The next day, Ryosuke, who is also Jun’s colleague, comes to the laboratory at 13:00 to prepare for his presentation. He concentrates on his tasks and finishes at 16:00.

Figure 4: Storyboards in An Example Scenario (2)

(6) He has a part-time job at 17:00, so he currently has some spare time. He checks the available micro-missions in the laboratory and finds Jun’s micro-mission. Kazuya says “Oh, I can do this micro-mission before going to my part-time job. It is convenient for me!” He decides to do it.

(7) A few minutes later, he has completed the micro-mission. The table has become pretty clean. He takes a picture of the clean table and reports the micro-mission as being complete with the picture. Jun is impressed by the report. Of course, he confirms its completion. After that, Ryosuke gets 10 bells as a reward for the micro-mission.

(8) Jun is grateful to all who participated in the micro-mission. He is able to comfortably use the table now. Kazuya, Aki and Haruka, who have co-funded the micro-mission, can use the table
comfortably, too. Ryosuke also feels happy because not only was he able to get a reward but also every participant of the micro-mission thanked him. This consequence leads him to be proud of completing the micro-mission. All participants are satisfied by using the service.

3.4 Prototype System

The micro-crowdfunding prototype system is composed of three components. The first component is an Android phone that possesses an NFC reader as shown in Figure 5. The second component is a computer that is connected to a server embedded in a small, common resource. The server is named Resource Management Server. The last component is a server that stores various information related to the micro-crowdfunding activities in a database. The server is named Micro-crowdfunding Server, which knows all Resource Management Servers. It also manages information about the statistics of micro-missions performed in respective Resource Management Servers. The information can be used to gamify micro-missions in the next step.

The system has been implemented as an HTML5 web application. Thus, the participants can start to use the micro-crowdfunding service easily with minimal effort.

![Figure 5: Prototype System](image)

Figure 6 shows the interaction between an Android phone and a Resource Management Server embedded in a small, common resource and storing information about a community that manages the resource. When a mission organizer touches the NFC card embedded in the small, common resource with his Android phone, a camera in his Android phone starts, with which he or she takes a picture of the small, common resource (I, II). When he or she inputs some information about the micro-mission and clicks the button, an event is delivered to the Resource Management Server for the small common resource (III). Then, the information, including a photo that shows the resource's current status, is stored in a database in the server. Afterward, mission investors receive emails that contain URLs (IV). In the retrieved forms, they specify the amount of the micro-mission’s funds by controlling a seek bar on their phones (V, VI). By touching a mission performer’s Android phone on the NFC card contained in a common resource (VII), its Resource Management Server returns information about currently available micro-missions (VIII), and he or she knows the micro-missions. Then, he/she chooses the missions that he or she may want to perform (IX). After completing a selected micro-mission, the mission performer touches the NFC card contained in the common resource (X) and registers a photo that shows the completed status (XI, XII), which is also delivered to the mission organizer via an email (XIII). After the mission organizer’s confirmation (XIV, XV), mission investors can see the success of their investment by clicking the URLs in the emails they receive (XVI, XVII).

![Figure 6: Interaction between Micro-crowdfunding Components](image)

We currently use NFC card and an embedded computer to realize the micro-crowdfunding prototype system, which makes resource management complex. Although the current system is not suitable for small resources because such devices do not fit into small resources and the costs are high, we expect that the future Internet of Things (IoT) will solve this issue soon. The basic idea of the IoT is that the pervasively present variety of things or objects around us can interact with each other and cooperate with their neighbors to reach common goals [3, 8, 22]. Using IoT allows us to integrate micro-crowdfunding into our daily environments.

4. EVALUATION

In this section, we present the experiment with the micro-crowdfunding prototype system explained in the previous section. In our experiment, the current focus of the evaluation was on how
economic factors and social factors affect both the individual and the community. We designed the micro-missions in the experiment based on the community-currency, role-playing game-based method [24]. The approach is effective in extracting meaningful insights without deploying the system in a real environment. In the experiment, the authors defined several possible micro-missions before the experiment. Each participant in the experiment was assigned a role of mission organizer, mission investor or mission performer. When assigned the role of the mission organizer, a participant chose one of the predefined micro-missions, and several participants whose roles were mission investors appropriated their virtual currency for the funding of the micro-mission proposed by the mission organizer. The mission performer explained how he or she performed the micro-mission to the other participants. The role of each participant changed in each turn, and we carried out several iterations so all participants would understand the purpose of the approach. The approach was effective for understanding how the participants used the micro-crowdfunding system.

Six people (three males and three females) participated in the experiment. The experiment was performed in our university for one day, and the ages of participants ranged from 25 to 51. The participants were of several nationalities (viz., three Japanese, one Taiwanese, one Malaysian, and one Bulgarian). After finishing the experiment, the participants were interviewed and answered a questionnaire. In the current experiment, the micro-missions were related to giving opinions and suggestions about possible solutions to important social problems. Some examples of such problems were global warming issues, aging society problems, discrimination, encouraging women in science and other goals. The micro-missions in the experiment were similar to the sessions in Professor Tanga’s Guess A Ware [4].

In the experiment described above, participants played one of the three roles: mission organizer, mission investor or mission performer. One person was a mission organizer, another person was a mission performer and the others were mission investors. Their roles changed for each turn. The sequence of activities executed in one turn could be described as follows: (1) the mission organizer organized the micro-mission; (2) mission investors funded the micro-mission proposed by the mission organizer; (3) the mission performer executed the micro-mission; (4) the mission organizer and mission investors thanked the mission performer; and (5) the mission organizer thanked the mission investors.

In each turn, participants completed one micro-mission. We decided that one set of the role-playing game included six turns, and we conducted several sets of the game.

4.1 The virtual currency concept

All of the participants were given 1,000 bells at the beginning of each set. The participants' currency was increased by executing the micro-mission as mission performers, and it decreased through the funding of a micro-mission. Additionally, we added extra rules in each set. The extra rules' concepts and objectives are described below.

Rule 1: Reward-reduction rule

In the scenario mentioned in Section 3.3, when the mission performer received a reward after executing a micro-mission, the amount of the currency given as a reward was the same as the sum of the money funded by the mission investors. Based on the reward-reduction rule, a participant could obtain half of the sum of the fund. We aimed to evaluate the effect of the reward-reduction rule on participants’ motivation, particularly for the mission performer. The reward-reduction rule was more realistic because the administrator of some projects or objects must manage the administrative cost, and a portion of the reward is allotted to that cost in many cases.

Rule 2: Aging-money rule

As mentioned in Section 3, the value of the money gradually decreased over time. The money decreased if the participants kept it (i.e., the currency aged), whereas funding led to no reduction. We expected that this fact would encourage the funding activity of the mission investors.

4.2 Economic incentives and users’ motivation

In this section, we consider the relationship between the economic factors and the participants’ motivations. We asked the following questions, which are related to the economic factors:

Q-E1 Were there any motivation changes for the mission performer in the case of the reward-reduction rule compared to the case without the reward-reduction rule?

Q-E2 Were there any motivation changes in the case of the aging-money rule compared to the case in which this rule was not adopted?

In Q-E1, four out of six participants responded that the reward-reduction rule did not affect their motivation, but the reasons were different for each participant. Some of the reasons were that “the virtual currency does not affect real life,” “the micro-mission’s goals are more important than the amount of the reward,” and “I think that the rest of the money will be used for realizing a sustainable society. It is okay.” On the other hand, the other two participants answered that it decreased their motivation. We expect that these differences are attributable to each participant’s personality, as described in [29]. Introducing the reward-reduction rule will affect the participants for whom collecting virtual currency is important, but it will not affect the participants for whom the micro-mission’s goals are most important. (However, we believe that the effect of the reward-reduction rule would be different when there is some relationship between the virtual currency and real life.)

With respect to Q-E2, the aging-money rule did not affect the motivation of a few of the participants. The reason is the same as the first answer to Q-E1: “The virtual currency does not affect real life” and “The micro-mission’s goals are more important than the amount of the reward.” Conversely, some results concerning aging money satisfied our expectations. Some of the participants said that they wanted to fund as much as possible, which increased the motivation for the mission performer. A participant said: “I strongly thought that I should use my currency as soon as possible. In the case that the aging-money rule was not adopted, I was thinking that it was better to keep my money for a more attractive micro-mission.” This comment shows that the aging-money rule encourages people to use their currency and to participate in the micro-mission. Additionally, with this rule, the participants felt the reality of the situation. The effect of reality is expected to be an important factor when designing services by adding virtuality to them using information technology [27, 30].

However, another participant said, “The aging-money rule had a negative effect on my motivation because my currency was decreasing in any case.” Participants like this feel as though they
are “suffering a loss”, which decreases their motivation. The other participants also said, “I will continue a micro-mission regardless of whether the goal of the micro-mission is significant or not for me.” Thus, the system should allow participants to enjoy achieving their micro-missions. Furthermore, another problem of the aging-money rule is that the total amount of money in the community will decrease. Thus, designing the appropriate aging rate would be a key factor for leading people into the flow state [5].

4.3 Social incentives and users’ motivation

In this section, we consider the relationship between social factors and the participants’ motivation. The following questions related to the social factors were asked:

Q-S1: In the experiment, you could know how much money others have funded to the micro-mission when you played the role of a mission investor. Did it affect your funding amount?
Q-S2: How would you feel if you were not thanked by others after completing a micro-mission as a mission performer?
Q-S3: How would you feel or how would you behave if you were asked by a stranger to contribute to a micro-mission?

Five out of the six participants answered that others’ funds affected their decision of how much to fund to a micro-mission. One participant said, “I cared about others’ opinions, and it was difficult to behave differently from others.” He also said, “Because there was no anonymity, I was more considerate when deciding to fund.” Thus, social factors are useful for preventing people from being inconsiderate, especially among acquaintances. Five people who answered that there were some effects on the amount of their funding to Q-S1 also stated that no expression of thanks would bring bad feelings in Q-S2. For example, they said, “In such a case, I won’t be able to continue to execute the micro-mission as a mission performer” and “I would become anxious about my performance.” These responses demonstrate that integrating others’ responses as feedback into the system is an efficient way to motivate users. Designing good communication among the participants is also important. Through the experiments, the system encourages and initiates communication among the participants. We strongly believe that micro-crowdfunding is useful for stimulating and initiating communication in the community in practical situations.

However, with respect to Q-S3, the result might be different for a case in which the participants are not acquaintances. In the case of a stranger, there is both a positive aspect and a negative aspect. On one hand, it will be easier to ask a stranger to execute a micro-mission that involves serious problems than to ask an acquaintance. One participant said, “I will be sensitive when asking an acquaintance to complete the micro-mission. I might feel bad due to the micro-mission, for example, especially if my acquaintance’s performance of executing the micro-mission couldn’t achieve my expected criteria.” On the other hand, the negative aspect might prevent participants from behaving actively when there is funding. Another participant said, “I will become more cautious when I fund because I can’t trust a stranger to the same level I trust my acquaintances.” If we use the system to activate the community, which includes strangers, it is very important to determine a way in which participants can easily join and participate in the micro-missions (i.e., lower the hurdle to participate).

After finishing all sets of the experiment, the participants answered a questionnaire. They evaluated the following items according to a five-point scale. Here, 5 was the most positive answer (e.g., excellent, very good, strongly agree, I could absolutely), and 1 was the most negative answer (e.g., very bad, strongly disagree, I couldn’t at all). These items targeted the participant’s conscience, feelings and emotions.

Q1: Could you share the importance of the problems with the other participants through the experiments?
Q2: Did you feel that the other participants’ opinions were useful to you throughout the experiments?
Q3: Were you glad to be thanked from the mission organizer when you funded the micro-mission as a mission investor?
Q4: Were you glad to be thanked by the mission organizer and mission investors when you finished executing the micro-mission as a mission performer?

Q1, Q2 and Q4 received high scores that averaged above 4.0. The commonality among the three questions relates to social factors. From the results of Q1, Q2 and Q3, we are certain that sharing ideas among people provokes considerable and deep thinking regarding the problems and can also cause changes in their thinking and emotions. With respect to Q4, the results show that social feedback from others helps people to participate in the micro-mission and makes them feel appreciated. Happiness is a powerful tool for continuing the given activities. When focusing on Q3 and Q4, although both Q3 and Q4 were about thanks, the score for Q3 was lower than that of Q4. We suppose that this discrepancy was caused by the difference in the level of feeling when contributing to the micro-mission between being a mission investor versus a mission performer. Designing additional incentives for mission investors is essential. We state concrete ideas about this issue in the next section.

5. DISCUSSION

This section presents six issues that were discussed while designing the current prototype. The first issue is to make it clear how our approach is different from the tax-based approach. In [33], a new way for realizing sustainable behavior change, called activity-based micro-pricing, was proposed. In this approach, a person pays a small amount of money when he or she consumes some small, common resource. Because the approach minimizes the transaction cost, we can charge a very small amount of money; as a result, the approach makes it possible to charge for people’s small activities. The objective of the approach is to offer a very lightweight payment method, such that people might not be aware of the existence of the payment. However, for achieving sustainability, people must eventually be aware of what they are currently contributing towards a sustainable society. In our approach, a person explicitly commits to contributing to a micro-mission, which we believe would increase the motivation to participate.

The second issue concerns the weakness behind the benefits of contributing to micro-missions. Of course, frequent participation in contributing to micro-missions would ultimately achieve a sustainable society due to increases in the participants’ intrinsic motivation. However, it is difficult for a participant to feel a satisfactory benefit because contributing to micro-missions looks similar to making a donation, where the donation works based on the person’s social incentive. As in the case of traditional crowdfunding services, a mission investor can expect rewards, such as rare items, tickets to rare events, or something that cannot be bought with traditional money.
Under the current design, when a micro-mission is completed, half of the money funded to the mission is returned back as a reward to the mission investors. During the time in which a mission investor is funding his or her money, its value is not degraded, which becomes an incentive and motivates him or her to fund more micro-missions. In this case, the aging speed of the currency is a critical issue for making micro-crowdfunding work well and preventing currency inflation.

The sustainability issue is essential for everyone, and we must account for how we contribute to it in our daily lives. In typical approaches, a social incentive is widely adopted to encourage people to act in more eco-friendly ways. However, there are personal qualities for which social incentives do not work well [29]. This circumstance means that the approach based on social incentives works well for people who like to cooperate or compete with others. In contrast, economic incentives usually work well for all personal qualities. Designing incentives that work well for all personalities is an important research topic when developing social mechanisms for everyone.

The current design allows any member in a community to propose new micro-missions and choose the price for completing micro-missions. This approach enables new micro-missions to be initiated anytime that anyone finds new tasks that must be performed to maintain the sustainability of a common resource. A problem with this approach is that there might be nobody willing to complete the micro-mission. In an alternative process, the person who would like to complete a micro-mission could propose it by himself or herself. However, in this case, verification of the quality of the micro-mission achievement is needed, but it is a challenging issue to motivate a person to verify a micro-mission. While designing the current prototype, we decided that the former approach is desirable because someone proposes a new micro-mission through rational and objective thinking and by considering the micro-mission to be necessary for maintaining the sustainability of the common resource and not to earn money for himself or herself.

We also need to consider how to control each community to propose a new mission that is consistent with the target goal of achieving a sustainable society. In [28], Sakamoto et al. presented the task of integrating a fictional character into existing physical games through a concept named transmedia storytelling [6, 26] to increase people’s awareness of pursuing more desirable lifestyles. Incorporating fictionality into micro-crowdfunding by assigning a fictional role to community members motivates them to propose and complete a micro-mission towards the target goal defined in micro-crowdfunding if a fictional story embedded as transmedia storytelling presents ideological messages that identify the micro-missions important to achieving the goal. Because the real world can be represented abstractly and sometimes ironically in a fictional story through framing to simplify or exaggerate essential and important concepts in our daily lives [46], people easily notice the concepts relevant to achieving an ideal, sustainable society. It also allows people to use more appropriate metaphors than in a real documentary or non-fictional story. In particular, Japanese animation stories contain complex ideological social messages towards futuristic lifestyles [30] to increase people’s intrinsic motivation. They can offer many effective metaphors to increase our self-efficacy through the positivity expressed in the stories. This approach also allows the micro-crowdfunding system to incorporate ideological incentives alongside the psychological incentives—for example, by highlighting empathetic values, aesthetic values, religious values, and luxurious/precious values [27]—and improves upon our current approach as a pervasive game that blurs the spatial, temporal, and social boundaries between fiction and reality by making the magic circle disappear [32].

6. CONCLUSION

The paper proposed a new approach to achieving a sustainable society based on the crowdfunding concept, which was called micro-crowdfunding. This approach leverages social and economic incentives for motivating members of communities to propose and perform missions and raising important social issues into conscious awareness by investing funds. The paper presented a basic concept of micro-crowdfunding and its prototype implementation. We also showed an experiment using the prototype system to extract insights behind how to use social and economic incentives through the role-playing-based evaluation method.

One problem with the current approach is the possibility that no one would be willing to maintain some common resources. Additionally, an infrastructure maintained by the tax-based approach is still necessary. For example, collecting garbage and disposing of it are not easy problems to solve with only a community-based approach. However, the insufficiency of taxes results from the cost of managing the sustainability of all of the common resources. It is an interesting problem to consider how to encourage people to contribute to the sustainability of unattractive common resources and to complement the existing tax-based approach with micro-crowdfunding.

We must also discuss how our virtual currency is circulated in a community in which aging money can be replaced with real products because changing money into products offers larger benefits. This circumstance might discourage people from investing money into micro-crowdfunding projects.

The national deficits in many developed countries are very serious problems. However, increasing taxes might not be a good solution because such increases could lead to reduced economic activity. Our approach, named micro-crowdfunding, is a first step toward solving this issue and is realized by increasing the awareness that people have toward the contributions they make to sustaining small, common resources.

REFERENCES


