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Survey-based Exploration of Attitudes to Participatory Sensing Tasks in Location-based Gaming Communities

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Abstract

An increasing number of participatory sensing applications have been developed in recent years. However, most of them are still in the early adoption phase and count only few users as compared to the billions of devices that could be leveraged. On the other side, existing location-based games, such as geocaching or Ingress, gain in popularity and attract up to millions of users worldwide. Since the players of location-based games are already exploring their environment, one approach could be to especially address these communities in order to increase the user base of participatory sensing applications. To this end, we conduct a preliminary questionnaire-based study involving 337 participants to investigate the possible attitudes of such players towards participatory sensing applications. In particular, we analyze the potential interests of our participants in sensing tasks based on their demographics, played games, and sensing modalities. Our results show that our participants would prefer contributing to sensing tasks when integrated in geocaching. Moreover, a point-based reward system would not significantly motivate them and could even have negative consequences.

Keywords:
Participatory sensing, mobile sensing systems, incentives

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1. Introduction

A myriad of new participatory sensing scenarios has been proposed in the last decade [1, 2]. In these applications, mobile phones are leveraged as a new generation of sensor platforms in order to collect information about the users and their environment. Example applications include monitoring noise pollution [3, 4] and traffic conditions [5]. Due to their ubiquity, mobile phones can contribute data in unprecedented quantity and quality. This data may not only benefit the application itself, but also the community at large. Since most applications have not been widely adopted yet, such benefits remain however limited so far.

The recruitment of volunteers to contribute to participatory sensing applications is challenging [6, 7]. Indeed, these applications demand particular efforts in terms of resources (e.g., time, battery lifetime, or data traffic) to the users. As a result, most users may refuse to contribute if the application benefits are not worth their investment. In order to address this issue, monetary-based incentive schemes have been proposed [8, 9, 10, 11, 6, 7]. This, however, requires that the applications have sufficient funding to reward users' contributions. An alternative perspective is to introduce gaming aspects that could serve as an engine for their participation [12, 13, 14, 15].

As compared to participatory sensing, location-based games already profit from large scale communities. For example, geocaching counts over 6 million players worldwide [16] with more than 1,820,000 caches published on Geocaching.com [16]. As of today, Munzee has over 60,000 players [17]) and around 800,000 Munzees have been deployed with a total of over 6 million captures [18]. Finally, Ingress totalizes 1 to 5 million downloads [19]. In these games, the players explore their environment to find caches, QR codes, or collaborate to virtually defend particular locations. As a result, they could be interesting candidates to contribute to participatory sensing campaigns.

We have therefore conducted a preliminary questionnaire-based study involving 337 anonymous participants belonging at least to one of the aforementioned communities. Based on the answers of our participants, we investigate the impact of multiple factors on their claimed motivation to contribute to participatory sensing tasks. Among potential factors, we especially consider demographics, played games, as well as different sensing modalities. For example, our results show that the participants would be more ready to contribute to sensing tasks when integrated to geocaching than using a separate application. Moreover, the introduction of virtual points and badges does not

appear to be a driving incentive for the participants and could even dissuade them to contribute to participatory sensing tasks. These findings are however specific to the selected location-based gaming communities and might not be valid when considering other user groups. Moreover, additional studies need to be conducted to examine possible discrepancies between the participants' answers to the survey and their actual behavior under real-world conditions as discussed in Sec. 5.

The paper is organized as follows. We first discuss related work in Sec. 2, before providing a brief overview of CachedSensing and its features in Sec. 3. We next detail our evaluation settings and present the associated results in Sec. 4. Discussions and closing remarks conclude this paper in Sec. 5 and Sec. 6, respectively.

2. Related Work

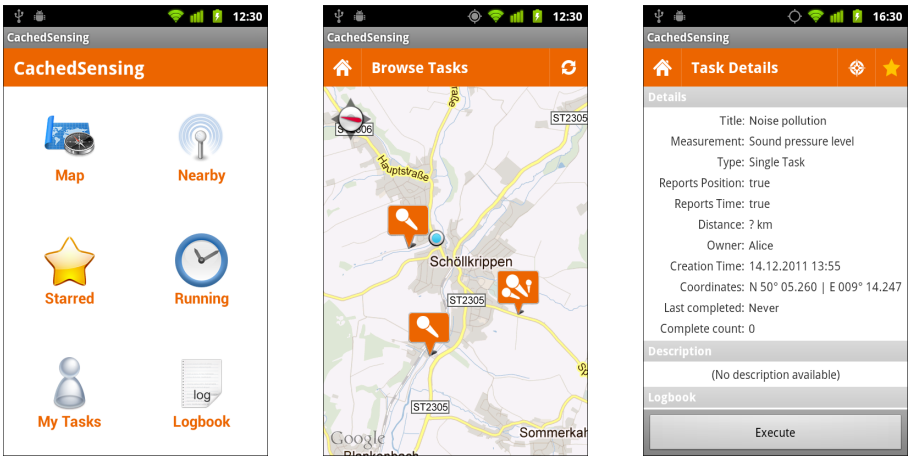
Most existing solutions rely on monetary incentives to motivate users to contribute to participatory sensing applications. For example, Reddy et al. proposed a framework [20] tailored to the recruitment of potential users based on their reputation, their spatiotemporal distribution, and the available budget allocated to the sensing campaign. Novel reverse auction models were introduced in [8, 9, 10, 11, 6, 7]. In these schemes, the users propose a bid for the sensor readings they have collected. The application can accept this bid and hence pay a reward for the collected sensor readings. Depending on the scheme, different parameters are taken into account to determine the value of the sensor readings. For example, the impact of privacy and remaining battery lifetime are considered in [8], while the sensing frequency, nearby sensing points of interest, and users' preferences are considered in [6]. The main goal of these schemes is hence to minimize the costs for the application campaigns, while simultaneously ensuring the overall quality and reliability of the data and thus of the application outcomes. The schemes, however, require funding to share between users.

However, not only remuneration may foster users' contributions, but also altruism and competitiveness [21]. For example, Luo et al. [22] proposed to reward contributing users by allowing them to access advanced features. However, this provider/consumer model requires bidirectional relationships between users that may not be applicable in all application scenarios. Additionally, Rula and Bustamante [23] use incentives inspired by location-based games, such as rewarding users when checking-in at individual locations. By

doing so, their goal is however to manipulate users' mobility patterns to offer better coverage, but not to motivate users to contribute more data as the primary goal.

CachedSensing shares similarities with *flora caching* [12], where users search for specific plant species. Once found, users photograph them and report their observations to the application. Flora specialists or other users can then follow the evolution of these plants. In contrast, CachedSensing allows users to both create and execute a more comprehensive range of sensing tasks including, e.g., noise level or cellular signal strength measurements, and hence covers a wider scope of application scenarios. In addition to propose a new approach to foster users' contribution, CachedSensing offers a not yet existing extension to existing location-based games. In *geocaching*, users hide objects called *caches* and publish their coordinates online. Other users then search for these objects and write their name on a logbook once they found them. While the caches can vary in terms of types, container sizes, terrain and difficulty ratings, no sensor data are currently collected. For example, *traditional* caches are containers with a pen and a logbook, while *multi-station* caches require users to visit the different cache locations in a predetermined order. Sophisticated caches may also involve the use of, e.g., WLAN, FM radio, QR codes or ultraviolet light ink. Indications about these caches and the associated logbooks are available on dedicated online platforms.

The concept of *Munzee* is similar to both geocaching and CachedSensing. Instead of using NFC tags, Munzee relies on QR codes (called Munzees). Each time a player finds out and scans a new Munzee, she gains points. However, no sensing tasks are performed. Like in Munzee, players need either a smartphone or a tablet to play *Ingress*. Ingress is a team-based role game, in which two factions compete to gain *portals*. A portal, i.e., a real-world landmark (such as fountains, monuments, and sculptures), is gained when several players from the same faction encircle it. Several portals can be linked to form a *control field*, whose area determines the score attributed to the faction. Each faction can prevent its adversary from gaining portals and forming control fields. Depending on the kind of actions, players either gain points or make use of them. The more points, the more powerful the players are and can thus create portals of higher levels or link them over further distances. In contrast to CachedSensing, no sensing measurements are taken, though.



(a) Main interface

(b) Map showing available tasks

(c) Task details

Figure 1: CachedSensing main screens

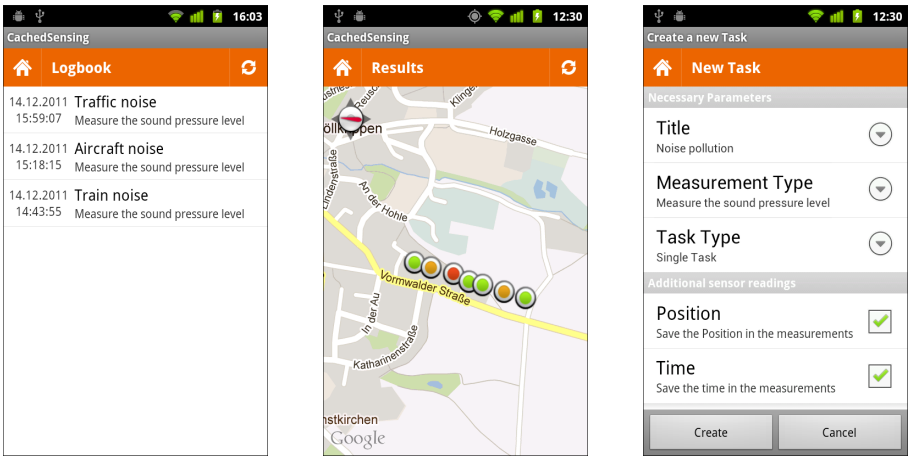
3. CachedSensing

We first provide an overview of CachedSensing [13], which serves as basis for this work. The CachedSensing architecture includes clients (i.e., the mobile phones of CachedSensing users), a server, and NFC tags. CachedSensing allows users to both perform and create sensing tasks according to the following mechanisms.

3.1. Performing Tasks

CachedSensing is based on sensing tasks stored on NFC tags and hidden by participants. The client application is organized around the main interface depicted in Fig. 1(a). Users can browse tasks either on a map shown in Fig. 1(b) or directly access tasks located in their vicinity. Moreover, users can save tasks of particular interest under their favorites and consult their currently running tasks (i.e., tasks involving multiple sensor readings that are still incomplete). Before starting to search for a tag, users can consult the characteristics of the associated task (see Fig. 1(c)).

Once users have chosen a task, they make use of the coordinates and information provided by its creator to find the corresponding NFC tag. Users then read the found NFC tag using their client, which displays the task details. Depending on the type of tasks, either users manually trigger the sensor



(a) Logbook (b) Map with collected sound levels (c) New task settings

Figure 2: Further examples of CachedSensing screenshots

measurements or the clients automatically perform them. In both cases, the collected sensor readings are then transmitted to the server, which creates a new logbook entry for the corresponding user in return (see Fig. 2(a)). Finally, the results are made available in form of statistics and displayed on the map illustrated in Fig. 2(b). For example, in the case of noise pollution monitoring, green markers represent low sound pressure levels, while orange and red ones indicate medium and low levels, respectively.

3.2. Creating Tasks

All users are also able to create new tasks. To this end, they first determine the task characteristics, including its title, the measurement type (e.g., picture, sound sample, sound pressure level, etc.), the task type (e.g., single, periodic, or multi-station), start and end dates, as well as additional information for other users to find it. For a periodic task, users also choose the number of sensor readings to be collected and the period between them. Once the *Create* button is selected, the new task is registered on the server. After the task registration, users hold the NFC tag close to the client and the task is automatically written based on the NFC Data Exchange Format (NDEF) [24]. Users next hide their tag in proximity of the location of interest and provide its coordinates to the server. Finally, users activate their tasks, which then become available to other CachedSensing users.

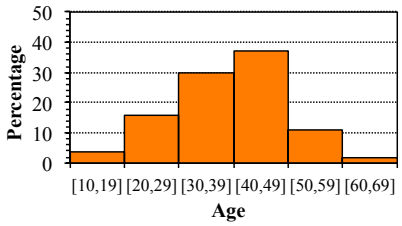


Figure 3: Distribution of participants' age (first quartile Q_1=31, second quartile Q_2=40, and third quartile Q_3=45)

4. Questionnaire-based Study

We next evaluate the potential interests of already active location-based players in contributing to participatory sensing based on our questionnaire-based user study. In what follows, we present both our settings and findings.

4.1. Settings

We herein focus on active players playing at least one of the three main location-based games detailed in Sec. 2, namely geocaching, Munzee and Ingress. We especially target these communities due to their large user bases. To approach these communities, we distributed our questionnaire on: (1) geoclub.de[2], (2) Google+ communities, and (3) Facebook groups on geocaching. The questionnaire is structured as follows. We first asked the participants about their experience in these games, before introducing the CachedSensing concept based on screenshots and a textual description. Next, we investigated their interest in contributing to sensing tasks and finally gathered their demographics. The questionnaire was in German and required approximately 10-15 minutes to be fulfilled. No incentives were given to the participants. Among a total of 449 persons, 337 participants thoroughly completed the questionnaire. We therefore only consider these participants in the remaining analysis.

4.2. Results

Our participants were predominantly male (n=279). Fig. 3 and Fig. 4 show their age distribution and played games, respectively. Tab. 1 summarizes the experience of the participants in the considered games.

[2]One of the largest German geocaching message board having also a dedicated forum for Ingress players.

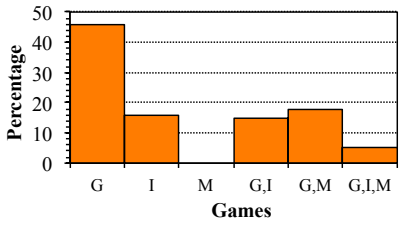


Figure 4: Distribution of played game(s) (G: geocaching, I: Ingress, M: Munzee)

Games	Active players	Past players	Not player but familiar with	Do not know it
Geocaching	77	8	15	0
Ingress	32	5	44	19
Munzee	7	17	43	33

Table 1: Comparison of the participants' experience in the considered games (in percent)

Our sample mainly includes active geocachers. Among those having already played, the number of found caches is between one and 12,000. Moreover, 83% of the geocachers have already hidden caches themselves. The number of hidden caches ranges between one and 150 with five as median. Our participants are hence more prone to search for geocaches than to hide new ones as confirmed in Tab. 2. Note that our participants invested up to 1,000 Euros for a cache (Q_1=10, Q_2=20, and Q_3=50). Since a NFC tag is cheaper than the indicated first quartile, the corresponding investment seems reasonable for potential CachedSensing players. When searching for geocaches, the participants use GPS devices (83%), Android smartphones (52%) or tablets (5%), iPhones (16%), iPads (4%), or other phones and tablets (1%) (multiple choices possible). Half of the participants are therefore equipped with NFC-enabled devices (e.g., Android smartphones), hence compatible with CachedSensing.

As compared to geocaching, Ingress and Munzee count fewer players in our sample. Note that 52% of the active Ingress players have reached the highest level 8 and can hence be considered as expert players. Overall, the participants play Munzee less frequently than the other games (see Tab. 2).

4.2.1. Willingness to Play

We first submitted the following statement to the participants: "*I would play CachedSensing*". The participants rated this statement using a seven point Likert scale. A score of one indicates a strong disagreement, four is

	min	Q_1	Q_2	Q_3	max
Searching caches	0	4	6	10	30
Hiding caches	0	0	0	1	5
Capturing Ingress portals	0	15	22	30	30
Linking Ingress enemy portals	0	4	10	20	30
Capturing Munzees	0	0	1	1	20
Deploying Munzees	0	0	0	0	10

Table 2: Average number of days per month during which participants contribute to the different tasks of the considered games

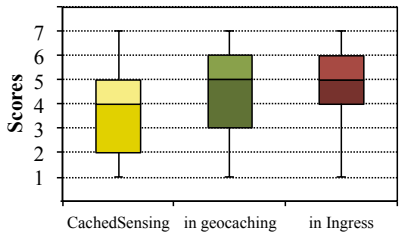


Figure 5: Minimum, quartiles, and maximum score attributed to the statements about the participants' willingness to play CachedSensing and its integration in geocaching and Ingress, respectively

neutral, and seven indicates a strong agreement. Fig. 5 shows the extrema and quartiles of the participants' answers. Overall, the participants' opinions are divided: 31% agreed, 37% disagreed, and 33% remained undecided.

A Kruskal-Wallis H test[3] shows that participants' age has a significant effect on their rating (p=0.017). In particular, a Mann-Whitney U test with Bonferroni correction[4] confirms that participants under 40 attributed greater ratings than the other age categories (p=0.000). Additionally, geocachers are significantly less willing to play CachedSensing (p=0.022), while Ingress play-

[3]A Kruskal-Wallis H test is a non-parametric test applied to verify whether more than two independent samples significantly differ from each other. The obtained p value determines the statistical significance of the result. In other words, it can be interpreted as the probability of getting similar (or more extreme) results when repeating the same questions on different samples. In all tests that follow, we consider the obtained result as statistically significant only if $p < 0.05$.

[4]A Kruskal-Wallis H test only indicates whether there is a significant difference between more than two samples. It however does not reveal the samples that differ. To this end, we therefore apply a post-hoc test that compares the samples pairwise. Again, a difference between two of these samples is considered as statistically significant only if $p < 0.05$.

Reasons	Number of participants	Including participant(s)
Lack of time	7	P_1
Insufficient motivation factor/playability	4	P_2
Fear to be led to uninteresting location	3	P_1, P_2, P_3
Smartphone incompatibility	3	
Measurements' reliability	2	P_1, P_2
Potential commercial benefits from data collection	2	P_3, P_4
Privacy issues	2	

Table 3: Reasons expressed by the participants why they would not play CachedSensing

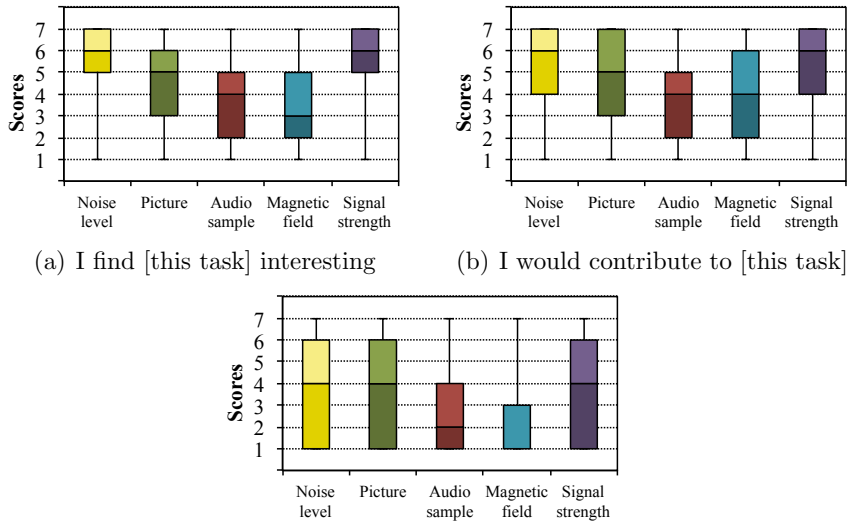
ers are significantly more ready to play it (p=0.001). This difference may be explained by the geocachers' willingness to stay closer to the nature than Ingress players, who mainly play in urban environments. Moreover, the fact that the participants own a NFC-compatible device does not significantly influence their willingness to play to CachedSensing (p=0.997). Tab. 3 compiles the most cited reasons given by the participants why they would not play CachedSensing. About potential benefits, P_3 explicitly wrote "It seems to me as if a commercial idea is the driver of this "game"", while P_4 expressed that "I do not want to have to do the work of others, even if it is hidden as a game. It is the responsibility of the individual groups to take care of their things and to show commitment".

Asked if "[they] would take a measurement when finding an NFC tag in a geocache" and the same if it would be integrated in Ingress, a majority of participants indicated that they would be ready to execute it as illustrated in Fig. 5. A Wilcoxon signed-rank test[5] further shows that the participants would be significantly more ready to take such measurement when integrated in geocaching (p=0.000). The difference is not significant in the case of Ingress (p=0.331).

4.2.2. What Sensing Modalities are Popular

Let us start with the general interest of the participants in different tasks. Fig. 6(a) shows that the participants are overall more interested in information on cellular signal strength followed by noise levels and pictures. In

[5]A Wilcoxon signed-rank test is a non-parametric test applied to compare the effects of a treatment on two related samples. In our case, this corresponds to comparing the answers provided by the same participants to different questions. As before, the value of p determines the statistical significance of the result.



(a) I find [this task] interesting

(b) I would contribute to [this task]

(c) I would create [this task]

Figure 6: Minimum, quartiles, and maximum score attributed to the statements focused on the sensor modalities

contrast, magnetic field data are the least interesting for the participants. Ingress players are significantly more interested than others (p=0.001) in all sending modalities. In contrast, geocachers are globally less interested (p=0.000).

The same observations can be done about the participants' readiness in executing the proposed sensing tasks. As before, the played games (p=0.000) and age categories (p=0.040) have a significant impact on their ratings. Geocachers are significantly less ready to contribute to the tasks (p=0.013), while Ingress players are more ready to do it (p=0.002).

However, all participants are significantly less interested in creating the proposed tasks than executing them (p=0.002). This reflects the current state in geocaching as well as in Ingress where players are more consumers than producers. The participants' preferences for the tasks to create however remain the same with lower interest from the geocachers (p=0.003) than the Ingress players (p=0.004). Furthermore, the answers confirm that participants having already deployed caches and/or Munzees are more willing to create tasks as compared to others who have not (p=0.012).

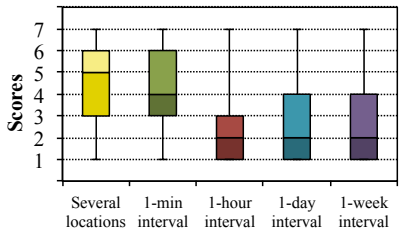


Figure 7: Minimum, quartiles, and maximum score attributed to the statements focused on the task location and frequency

	Action	Points
Task execution	Standard task execution	10
	Additional execution after more than 5 min	5
	Additional execution after less than 5 min	3
	Additional execution after less than 1 min	1
	First user to execute the task	20
Task creation	Task creation	5
	Execution of created task by another user	1

Table 4: Proposed point-based system

4.2.3. Location and Frequency Preferences for Task Execution

Fig. 7 displays the extrema and quartiles of the participants' answers about their preferences in terms of location and frequency modalities. The participants prefer when tasks are placed at different locations or to be executed within short time intervals. Surprisingly, participants having a preference for multi-station caches do not significantly appreciate sensing tasks located at different locations (p=0.393). The participants' age influences their willingness to repeat measurements in an hourly (p=0.021), daily (p=0.000), or weekly basis (p=0.000). Participants up to 40 are ready to contribute more frequently than older ones. Note that this observation is in line with the previous results about the sensing tasks in general. The ratings however remain relatively low probably because periodic tasks are uncommon in the considered games and visiting the same location may not be attractive to most users, especially in remote places.

4.2.4. Utility of Point-based Rewards

We next explore whether introducing point-based rewards would further foster the participants' contribution. To this end, we have proposed the system presented in Tab. 4 to the participants as an example. Fig. 8 and

Fig. 9 summarize the extrema and quartiles of the participants' ratings to the submitted statements. The point-based rewards do not significantly influence the participants' interest in playing CachedSensing. Overall, Ingress players and young participants are more positive about the introduced point system than geocachers and older people.

To our surprise, 13 participants (including P_5) however clearly expressed their disagreement with the introduction of such a point-based system. The most cited reason is that "it would destroy the original idea of the game" and it may "potentially have negative consequences as already experienced in geocaching". For example, "point system" (Statistics!) has broken a lot of the original Geocaching spirit.... Any competition is inappropriate, since it will lead to unpleasant excesses". Instead of relying on point-based rewards, a participant suggested that "an exciting story that is continuously embedded into a game or funny and surprising stations" would be a better alternative.

This trend is confirmed by the participants' ratings to the statement "competing with others would be important for me" (B in Fig. 8). Ingress players (even if they play to the other games) attributed higher ratings (p=0.000) probably due to the existence of virtual incentives in Ingress. Geocachers may be motivated by other factors, such as discovering novel and interesting places. Moreover, participants between 20 and 29 rated the competition factor as more important than those between 40 and 59. Participants commented that competition is not necessary in their free time:"I have enough competitive pressure in my everyday life. I do not need that in my spare time. I will decide what I do, when, where and how often."

Finally, the participants are undecided about the fairness of the proposed point-based system (see G in Fig. 9). Six participants including P_5 commented that the scheme seems to be reasonable, but that they would not personally be motivated by it. Two participants found the benefit of CachedSensing interesting enough that no other motivation factors should be required: "The whole thing should be useful, that's why no points are needed" and "I don't need incentives for meaningful and good ideas". As compared to the previous statements, our participants are more favorable to the introduction of awards or virtual badges for special achievements (see H in Fig. 9).

4.2.5. Free-text Comments

Several participants criticised the lack of underlying motivation for the users, such as discovering new places and making long walks as in geocaching.

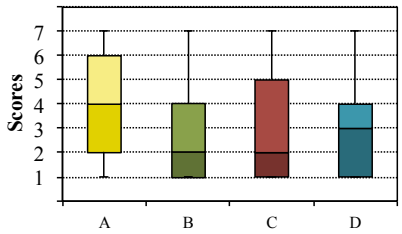


Figure 8: Minimum, quartiles, and maximum score attributed to the statements focused on the point-based incentive scheme: (A) I would play CachedSensing with such a point system, (B) Competing with others would be important for me, (C) I would create more tasks, and (D) I would contribute to the same task more often

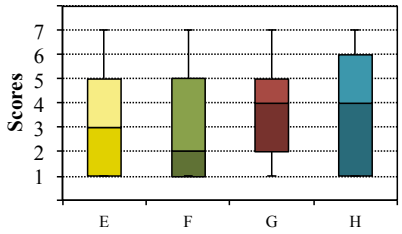


Figure 9: Minimum, quartiles, and maximum score attributed to the statements focused on the point-based incentive scheme: (E) I would contribute to different tasks more often, (F) I would try to be the first to contribute to a task, (G) I find the proposed incentive scheme fair, and (H) Additional awards or virtual badges should be granted to users for special achievements

With nature-oriented sensing tasks, this could however be possible. A participant regretted that there would be no surprise when finding NFC tags as compared to geocaching containers, since they look all the same. Five participants including P_6 would wish an alternative to NFC tags and/or an iOS application, while another participant proposed to extend the scope of the available sensor readings to videos. Both extensions could be easily implemented by introducing QR codes as alternative task support as well as further sensor modalities in the current CachedSensing implementation.

Three participants were particularly doubtful about the underlying intention of CachedSensing and suspected its exploitation on a commercial basis instead of a crowdsourcing game. For example, P_6 wrote "Are you a game? or are you collecting data? Clarify that and conduct yourselves accordingly". Additionally, a participant commented that "Let it be. If you want to quickly

scan, play Munzee. If you want to fight and play, play Ingress. Who want to hold a can in his hand, plays geocaching. Who wants to have data, should stay out of the player scene. The commercial benefits of CachedSensing are too obvious (clearly they are also in the other games, but not so obvious). No one likes it, it is just repulsive ". Another participant"[found] the idea to have commercial tasks (creating a noise map) created in this way "for free" is borderline and will surely encounter criticism". This aspect should therefore be better explained in future deployments.

Besides, we got positive comments. For example, "Cool idea :)", "I found the idea good, but the point system is really really really creepy", "Interesting idea! Almost everybody has a smartphone and could theoretically execute tasks", "Let's try it", "How can I participate? ;-)", "I would like to test it and I think that the idea good is as soon as it is nicely playable. If you start a bigger test and I have a new smartphone, I would like to try it", and "If a nationwide and balanced expansion were possible/successful, I would try!".

5. Discussions

The results show that the enthusiasm of our participants for sensing activities is limited. Overall, they are globally more willing to contribute to existing sensing tasks than creating new ones. This trend is also observed in online communities [25], such as Wikipedia [26, 27] or discussion groups on Usenet [28, 29], where only a minority of users actively contribute content. According to [25], this behavior relies on economic models and theories. For example, it has been shown that the users' motivation to contribute to the maintenance of a good will be limited if this good is freely available and can be used without limitations [30]. The fact that the participants may not have felt part of the participatory sensing community may also have influenced this result, as it appears that the sense of belonging to a community is an important motivation factor [25].

Moreover, the suggestion to introduce a point-based reward system has globally not been positively rated by our participants, especially by the geocachers. Overall, the participants indicated not to be particularly motivated by competing with others. Similar results have been also demonstrated in other online communities. For example, some computer role-playing gamers are more interested in socializing than in competing [31]. The same is observed for open source developers. Some of them like the competition aspects, while others prefer contributing for the pleasure of programming [32].

As a result, it would be interesting to further study motivating factors in location-based gaming communities to determine if both categories can also be found in this context, while only one has been particularly highlighted in our results.

In our questionnaire-based survey, the participants do not perceive rankings as a key motivating factor. This result is consistent with [33, 34]. In [34], an online tourism community indicated that "sharing enjoyment" or "group attachment" are more motivating than "attaining status in the community" or "gaining prestige". Additionally, it was shown in [33] that rank increases do not necessarily imply increased intrinsic motivation in the open source community. However, it exists differences in terms of motivating factors between communities [35]. For example, open source software developers are more sensitive to personal development and reputation than open source content contributors, who are in turn more sensitive to altruistic aspects [35]. Therefore, additional studies dedicated to location-based gaming communities are needed to be able to draw further conclusions.

Besides, our participants indicated that they would be more interested in contributing to sensing tasks when those would be integrated in existing games as they may not be able to allocate additional time to still another game to play. Such integration however depends on the openness of the games and their administrators. For example, in geocaching, users can easily create new caches using, e.g., wireless beacons. In contrast, an integration into Ingress would be more difficult, even if sensor data are already collected within the scope of the game.

The participants' comments have however revealed that the surveyed communities are overall both greedy and altruistic. For example, they would be ready to contribute if participatory sensing would be fun, but would refuse if it would serve commercial interests. Such observations hence raise further questions about the feasibility of large scale participatory sensing deployments that need to be investigated in future work. For example, the conditions under which participants would be willing to contribute to participatory sensing should be further examined. Studies about the underlying motivations of participatory sensing campaigns, such as potential commercial interests, should also be conducted. Similarly, the concept of communities should be analyzed to better understand how to foster the participants' sense of belonging in this context as well as maintain their motivation over time.

Our study has finally some limitations that should be mentioned. As in all questionnaire-based studies, the answers provided by the participants reflect

their claimed opinions, but not necessarily their actual behavior. To explore it, a real-world deployment should be conducted. Moreover, our sample may be biased and not representative of the whole considered communities. Indeed, the fact that they voluntarily answer our questionnaire may indicate that they may be more altruistic or interested in new games than those who have not answered it. Ultimately, our findings mainly reflect the views of the geocaching and location-based gaming community and may not be consistent in other contexts.

6. Conclusions

Within the scope of this paper, we have examined based on a questionnaire-based study whether players of location-based games would be interested in contributing to participatory sensing. Despite the fact that our participants already explore their environment, their claimed interest remains limited. Overall, young and Ingress players appear to be more interested especially in collecting cellular signal strength measurements than geocachers. The main reason given by the participants for their limited interest is a lack of time to play still another game during their leisure time. We have also shown that virtual points may not increase the participants' motivation to contribute. On the contrary, competition may rather lead to disinterest or drop outs as explicitly expressed by several participants. As a result, the surveyed location-based gaming communities may not be overly enthusiastic about sensing activities. In the future, it would be interesting to compare the results obtained with these communities to other user groups and examine potential differences in terms of interests and motivation factors.

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