Work Motivating Factors of the Communications in a Crowd-Powered Microvolunteering Site

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Abstract. Various systems have been developed to support and motivate volunteer activities for people with disabilities. "Minna de DAISY" is a microvolunteering system, powered by an open-source social networking system and web application, of character corrections. This system demonstrated that digital books could be efficiently produced for the visually impaired through the manual correction of errors using volunteers. According to participant interviews, those who were aware of their social contribution had a higher motivation to do social work. The feeling of community involvement promoted continuous participation. However, these studies do not precisely discuss the contribution of communication between system managers and participants. Some literature reported that interactions in a social network improved participant awareness of the purpose of their work. In this study, we aim to demonstrate the effect of communication on participant motivation and likelihood to continue microvolunteering.

Keywords: Crowdsourcing · Motivation · Communication · Social networking · Microvolunteering · Facilitation

1 Introduction

Along with the increased popularity of crowdsourcing, an increasing number of crowd-powered volunteering websites have emerged. There have been conceptual studies that aim to help people with visual impairments using volunteers. The *social accessibility* program proposed by Takagi et al. aims to improve the accessibility of inaccessible websites [26]. *VizWiz* proposed by Bigham et al. enables visually impaired smartphone users to identify items in the real world [3]. We also proposed and evaluated a crowdsourced digitalization concept for handwritten real-world accessibility information [22]. From the results of these studies, we

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show that the collective power of crowdsourcing volunteers can improve accessibility more quickly than using only local volunteers.

Recently, Kobayashi et al. developed a microvolunteering system called *Minna de DAISY* (the "DAISY by everyone" in English), [19] powered by the open-sourced social networking system (SNS) OpenPNE, and a character corrections web application [16,23]. This system showed that by using volunteers, it was possible to efficiently manually correct errors in text DAISY (Digital Accessible Information SYstem) that had resulted from the optical character recognition (OCR) of scanned books. They analyzed both motivated and unmotivated system participants and the factors that contributed to their motivation levels [19]. According to interviews, participants who were aware of their social contributions had more motivation towards social work, and their feeling of community identification promoted continuous participation. They also reported that there were encouraging effects associated with game-like feedback and visualization elements.

However, these studies did not precisely discuss or analyze the effect of communication between system managers and participants. Some literature reported that interactions in company's and business' SNSs are one of the most important factors towards work performance [8]. In this study, we aim to demonstrate the effects of communications within the SNS on the participants' motivation to microvolunteer. We mainly analyzed communication logs in our microvolunteering system as mentioned above, and investigated its influences on volunteers' actions, such as their continuous involvement and performance.

Our research questions are as follows:

Q1. What are some characteristics of communication with well-performing workers?
Q2. Can the responses of the microvolunteering site operator of contribute to the members' performances?
Q3. What are elements of the effective facilitation for operators?

2 Related Work and Issue on This Study

Various systems have been developed to support and motivate volunteer activities for people with disabilities. Recently, more assistive tools for facilitating volunteer activities have been developed. This is due in part to the popularization of smartphones for people with and without disabilities, and the increased awareness of the utility of concepts such as collective intelligence, crowdsourcing, and human computation [14,18,25].

2.1 Crowd-Powered Volunteering Systems for Securing Real-World Accessibility

One of the representative tools is *VizWiz*, proposed by Bigham, that can help visually impaired people recognize graphical information in the real world [3].

In the *VizWiz* scheme, when the visually impaired take and upload a picture of something they want to know, volunteers tell them what it is. Lasecki et al. have continued to improve and evaluate *VizWiz* by implementing a function for streaming video and audio [20]. In addition, a variety of similar tools are available using smartphones. Smartphone applications such as *TapTapSee*, *CamFind*, and *Talking Googles* can be downloaded from the *AppStore*, and be evaluated on their usability [13].

In addition to these applications, there are systems that share real-world accessibility conditions. Holone et al. developed a system that hovered entered accessibility conditions on the *OpenStreetMap* [12]. However, based on an evaluation of the system in Norway, it was reported that there were some issues, such as securing and sharing quality accessibility information, privacy, and security problems. Tarkiainen et al. proposed a web-based system for checking accessibility conditions in Finland [28]. In addition to what was done in Finland, Goncalves et al. developed a tool that easily shared accessibility conditions. They reported that by using the tool, users' awareness of environmental accessibility and their willingness to participate in volunteer activities was raised [10]. Hara et al. proposed a crowd-powered accessibility condition checker on bus stops using *Google Street View* [11]. In this system, crowd workers were asked to select the location of accessible or inaccessible bus stops and traffic signs. Based on the results of machine learning using the workers' markings, the system automatically recognized public transit locations. Moreover, Miura et al. proposed the concept of crowd-powered conversion that could convert handwritten accessibility information provided by professionals in disability service offices to electronically accessible information [22]. They compared crowd conversion results with the previous results from a real-world accessibility assessment [21], and then reported that the results from crowd worker input and assessment volunteers were similar. To improve information quality, like other researchers, the authors emphasized the importance of the facilitation of worker collaboration.

2.2 Microvolunteering Systems for the Accessibility of Web Materials and Downloadable Contents

In the last ten years, many studies focused on improving the accessibility of digital media have accumulated.

The *ALT-server*, one of the initial studies on securing web site accessibility, had volunteers enter alternative text for images on web pages [7]. *WebInSight* improved the efficiency of this scheme by combining it with image analysis [4]. Takagi et al. proposed the *social accessibility* concept system that improves the accessibility of inaccessible websites using volunteers [26]. In this concept system, when computer users with blindness, or volunteers, reported problems with an inaccessible web page, volunteers modified the problems according to system guides. Though these projects had some positive results, according to the study, the problem arose on how to ensure and sustain volunteer numbers [27]. They also pointed out the necessity of ensuring an effective motivating structure to maintain the worker community.

Various studies have examined the creation scheme of books for people with visual impairments. *Bookshare* created almost 0.3 million accessible books utilizing a combination of a library support system and a support framework for people with disabilities [1]. Kobayashi et al. proposed and evaluated a microvolunteering system [2] that can streamline the creation of accessible text DAISY books using crowdsourced volunteers [19]. According to their research, 537 participants, 34 % of which were seniors, conducted over 17 million micro-tasks, such as character corrections. In this system over 1100 text DAISY books were created in two years. They found that young and elderly participants contributed to the creation of text DAISY over the short and long-term, respectively. In addition, they were able to maintain participant motivation by helping them visualize their contributions. Since we expect that seniors will gradually become more interested in crowd work [6], additional studies are needed to discuss motivational maintenance methods that appeal to not only young but also senior crowd workers.

2.3 Analysis of Social Network Sites (SNSs)

Social network sites (SNSs) are web-based services that facilitate the creation of relationships among participants. According to Ellison's definition, these sites provide individuals with three functions: (1) constructing a public or semi-public profile within a bounded system, (2) articulating a list of other users with whom they share a connection, and (3) viewing and traversing their list of connections and those made by others within the system [9].

The relationship-building function provided by an SNS enables the provider to not only reinforce mutual connections among many unspecified members, but also to connect business partners and partners-to-be, and to record and analyze communication concerning specific events. For instance, in the case of a disastrous earthquake, a microblogging site provided their users with the ability to exchange their information. Specifically, they were able to exchange information on damages done and their evacuation location, in addition to sharing their feelings and comforting each other [24]. DiMicco et al. demonstrated that interactions in a company's SNS can enhance their awareness of their contribution to the company and thus enhance their work performance [8]. The *TurkOpticon* served as a quasi-union for crowd workers in the *Amazon Mechanical Turk* and helped facilitate a healthy relationship between clients and workers [15].

Most microvolunteering sites exploit SNS functions. A recent study by Kim et al. revealed that SNSs are able to engage younger generations in philanthropy. This is due to the social capital formed by SNSs that is used to promote awareness of volunteer activities [17]. The previously mentioned *VizWiz* incorporated characteristics of SNS and was released as VizWiz Social, which provided a friendsourcing function [5]. The aforementioned *Minna de DAISY* also integrated SNS elements, such as a forum and microblogging functions to facilitate smooth communications among the participants and managers [19]. These features particularly encourage young participants.

Table 1. The number of member IDs in the end of 2013, 2014, and 2015.

Year	2013	2014	2015
The number of new member IDs	299	149	314
The cumulative number of member IDs	299	448	762

However, to date, the type of interchanges contributing to motivating volunteer work remains unclear. In addition, in most other systems, little is known about how SNS communications vitalize users and increase microvolunteering awareness. Therefore, we decided to set research questions as mentioned above and analyze conversation logs from a microvolunteering site.

3 Materials and Method

The material includes the communication logs obtained from the microvolunteering system "Minna de DAISY" [2] in the period from October 2013 to December 2015 (800 days). The records can be divided into two types: members' microblogging comments and comments in the forum-type Q&A system. The former can be characterized as *Twitter*-like short comments displayed in a timeline-like manner. The latter can be categorized as a community-based bulletin board system that non-anonymized members mainly use to discuss how to correct OCRed books. The two logs include 1345 tweets and 3154 comments, respectively. These logs are associated with 537 member accounts (the number of IDs was 762, as shown in Table 1) and can be analyzed based on network analysis. Also, some of these tweets have tags including five category types such as general notices, requests for a text DAISY, notifications of brand new books, Q&A on corrections, and sandbox, as shown in the upper part of Table 2.

In this report, we mainly analyzed brief characteristics of the tweets. First, we added tags to the tweets that had no tag. The additional tags included seven categories such as communications, greetings, general Q&A, progress tweets, irregular notifications by administrators, server problems, and discussions on the system & interfaces, as shown in the lower part of Table 2. Then, we checked the relationship between characteristics of the participants and the corresponding tweets contents. Second, transitions of tweet communications and relationship among participants and the operator group were analyzed based on directed graphs of partial and entire periods. The graphs were generated with the R statistical language and the SNA package. At that time, we calculated some centrality indices and then discuss the participants' connections network of the microvolunteering site. The centrality indices included centralities of information, betweenness, PageRank, and degree, as illustrated in Table 4.

4 Results and Discussion

4.1 Tweets Categorization

Table 2 shows the tweets breakdown classified by brief and specific categories. The tweets in the notifications by the system & administrators category mainly included requests for a text DAISY that probably were posted by visually impaired volunteers. As expanding the scale of the microvolunteering site, this tendency became strong.

Table 2. Tweets breakdown classified by brief and specific categories in entire period (October 2013 – December 2015), 2013, 2014, and 2015. Since some of the tweets classified by the authors had some tags, a total of these tweets were larger than exact number of the tweets.

Category		Frequency			
Brief category	Specific category	Entire	2013	2014	2015
Notifications by the system & administrators	General notices	34	5	20	9
	Requests for a text DAISY	216	3	90	123
	Notifications of brand new books	197	63	129	5
	Q&A on corrections	184	57	31	96
	Sandbox	21	4	4	13
Subtotal:		652	132	274	246
Not notifications	Communications (Whole)	381	135	194	52
(Classified by the authors)	Communications, greeting	37	22	13	2
	Q&A, general	16	5	9	2
	Individual progress	47	18	21	8
	Irregular notices by administrators	107	18	67	22
	Server problems	76	7	39	30
	Discussions on the system & interfaces	133	29	99	5
Subtotal (tags):		797	234	442	121
Subtotal (exact number of tweets):		693	204	379	109
Total (tags):		1449	366	716	367
Total (exact number of tweets):		1345	336	653	355

In the category "not notifications," there were many irrelevant interactions to book corrections. However, the number and rate of these tweets tended to decrease (66 % (2013) → 51 % (2014) → 48 % (2015)). The same tendency can

Table 3. Tweets breakdown classified by tweeted participants category in entire period (October 2013 – December 2015), 2013, 2014, and 2015. These categories were defined by Kobayashi, et al. [19].

	Classified group (ref. Kobayashi, et al. [19])					
	Top performers	Spectators	Occasional workers	Longtailers	Unclassified	Admin. & system
2013	11 (16 %)	5 (7 %)	14 (21 %)	0 (0 %)	0 (0 %)	38 (56 %)
2014	36 (31 %)	4 (3 %)	3 (3 %)	4 (3 %)	0 (0 %)	71 (60 %)
2015	9 (26 %)	1 (3 %)	2 (6 %)	11 (31 %)	0 (0 %)	12 (34 %)
Entire	56 (25 %)	10 (5 %)	19 (9 %)	15 (7 %)	0 (0 %)	121 (55 %)

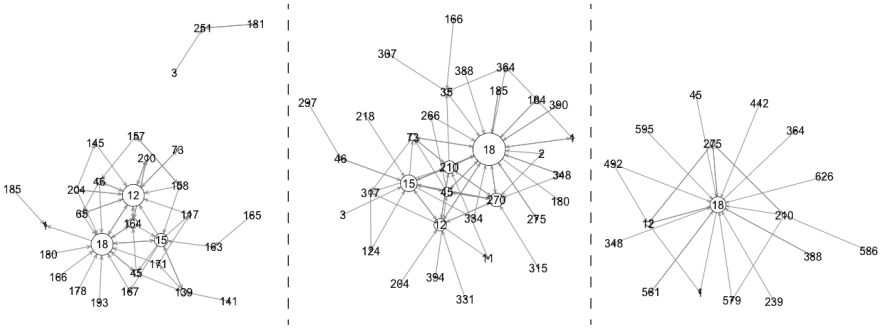

Fig. 1. Directed graphs of the participants' communications in 2013 (left), 2014 (middle), and 2015 (right). The size and the numbers of edges represent degree of connections and participants' IDs, respectively.

be observed in the tweets about individual progress. As the microvolunteering site matured, participants had become to communicate less each other and to concentrate more on their job. The discussions on system and interface in 2013 and 2014 are more than that in 2015. This fact was because the start-up stage of the microvolunteering site had more problems in the system architecture and the interface while in 2015, the interface became improved and sophisticated, and the participants became familiar with the system.

Table 3 shows the number of tweets in the category of "not notification" classified by the user performance. This user classification was employed along with the study by Kobayashi et al. [19]. Excluding the category "admin & system," the top performer group tweeted more than the other groups in all periods. In particular, the contents of top performers' tweets occupied most in all the categories in Table 3.

4.2 Directed Graphs and Centrality Indices

Figure 1 shows directed graphs of participants' tweets communications in 2013, 2014, and 2015. In all the periods, the participant #18 played a most

Table 4. Centrality indices calculated based on the directed graphs shown in Fig. 1. The indices includes information, betweenness, PageRank, and degree centralities.

2013								
Order	ID	Information	ID	Betweenness	ID	PageRank	ID	Degree
1	18	1.08E-14	18	35.3	18	0.064	18	0.181
2	12	1.08E-14	15	18.8	12	0.047	12	0.142
3	15	1.08E-14	12	17	15	0.039	15	0.116
4	164	1.08E-14	139	5.6	251	0.023	164	0.065
5	45	1.08E-14	1	5.2	164	0.022	45	0.052
6	46	1.08E-14	163	5.2	139	0.02	46	0.052
2014								
Order	ID	Information	ID	Betweenness	ID	PageRank	ID	Degree
1	18	7.435	18	38.2	18	0.061	18	0.154
2	15	5.279	15	19.7	15	0.035	15	0.089
3	210	4.622	12	10.5	12	0.025	12	0.065
4	270	4.379	35	8.2	270	0.025	210	0.065
5	12	4.011	270	6.4	210	0.024	270	0.065
6	45	3.458	210	6.1	45	0.019	45	0.049
2015								
Order	ID	Information	ID	Betweenness	ID	PageRank	ID	Degree
1	18	11.465	18	85.8	18	0.053	18	0.435
2	12	2.898	210	12.2	210	0.014	12	0.116
3	210	2.599	12	1.2	12	0.013	210	0.116
4	275	2.564	275	0.8	275	0.01	275	0.087
5	579	1.787	1	0	579	0.007	1	0.058
6	1	1.78	2	0	1	0.007	492	0.058

important role in the interaction network, and the #12 and #15 also contributed much to the network. Since all of them belonged to the administrator group, the communications in the microvolunteering site resulted from the dedicated and frequent communications by the administrator group. Table 4 illustrates the top six centrality indices in the participants' group. The table indicated that #18 performed best in all the period and all the indices. This fact also suggested that the microvolunteering site comprised similar social network to star network. As time passed by, the relative influence of #18 tended to increase because the frequency of tweet communication decreased particularly in 2015. Excluding the administrator group, most of the participants with the high centralities such as #164, #251, #210 belonged to top performer group. This fact can be suggested that this kind of communication can promote the activities of the volunteers.

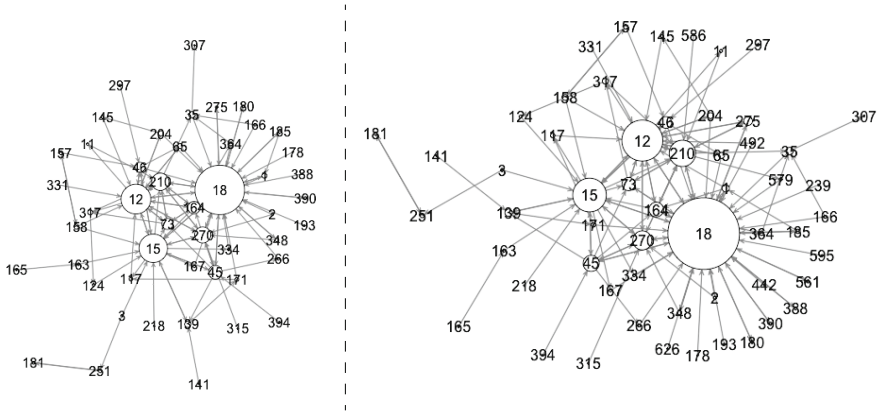

Fig. 2. Directed graphs of the participants' communications in 2013–2014 (left), and the entire period 2013–2015 (right). The size and the numbers of edges represent degree of connections and participants' IDs, respectively.

Table 5. Centrality indices calculated based on the directed graphs shown in Fig. 2. The indices includes information, betweenness, PageRank, and degree centralities.

2013–2014								
Order	ID	Information	ID	Betweenness	ID	PageRank	ID	Degree
1	18	6.983	18	32.2	18	0.066	18	0.134
2	15	6.109	15	22.3	15	0.041	15	0.084
3	12	5.403	12	9.6	12	0.034	12	0.074
4	210	4.385	3	5.1	210	0.02	210	0.045
5	45	3.896	46	4.6	45	0.019	45	0.04
6	164	3.871	45	4.1	270	0.019	270	0.04
2013–2015 (Entire period)								
Order	ID	Information	ID	Betweenness	ID	PageRank	ID	Degree
1	18	9.167	18	36.8	18	0.061	18	0.144
2	15	6.97	15	19.5	15	0.029	12	0.076
3	12	6.836	12	9.8	12	0.029	15	0.072
4	210	5.531	210	5.3	210	0.02	210	0.051
5	164	4.309	3	4.5	270	0.014	45	0.034
6	270	4.261	46	4.1	45	0.014	270	0.034

Figure 2 shows the transitions of the social network in the microvolunteering site. It can be found that there are the increase of the edges and the nodes and the connections concentration to the particular participants including administrators (#18, #12) and top performers (#210). Table 5 describes the top six centrality indices in the participants' group in the periods 2013–2014 and 2013–2015. There

are similar tendency to Table 4 while the unobserved ID #3 can be found in the category of betweenness centrality. Since this centrality index is reflected by the frequency of mediated communication, #3 mainly contributed to the network as the mediator of communication among the participants.

From the results mentioned above, work motivating factors of communications in the microvolunteering site can be concluded as the smooth facilitations by operator group. Their frequent communications and diligent responses to volunteer participants can develop and increase the participants' awareness to contribute the site and continue the job on the site. The participants who conducted tweet communications tended to belong or came to belong to the group of top performers, though not even that, the group of longtailers. For motivating these performers, it is important for operators of microvolunteering site to interact them frequently and sincerely.

5 Conclusion and Future Work

For demonstrating the effects of communications within the social network on the participants' motivation to microvolunteer, we analyzed communication logs in the microvolunteering system named *Minna de DAISY*. We also discussed its influences on volunteers' actions, such as their continuous involvement and performance. The achievements of this report are as follows.

- Based on the results of the tweet breakdown, the participants belonging to top performer group tended to not only work more than the others but also communicate frequently in the social network on the microvolunteer site.
- Work motivating factors of communications in the microvolunteering site can be concluded as the smooth facilitations by operator group. In order to motivate these performers, it is important for operators of microvolunteering site to interact them frequently and sincerely.

Our future work includes more detailed analysis of the communication logs. Though we mainly analyzed the relationship of communicated participants, it is also important to check the specific contents of the logs.

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References

1. Bookshare. http://www.bookshare.org/
2. Minna de DAISY. https://ebis.cyber.t.u-tokyo.ac.jp/

3. Bigham, J.P., Jayant, C., Ji, H., Little, G., Miller, A., Miller, R.C., Miller, R., Tatarowicz, A., White, B., White, S. et al.: VizWiz: nearly real-time answers to visual questions. In: Proceedings of the 23nd Annual ACM Symposium on User Interface Software and Technology, pp. 333–342. ACM (2010)
4. Bigham, J.P., Kaminsky, R.S., Ladner, R.E., Danielsson, O.M., Hempton, G.L.: WebInSight: making web images accessible. In: Proceedings of the 8th International ACM SIGACCESS Conference on Computers and Accessibility, Assets 2006, NY, USA, pp. 181–188. ACM, New York (2006). http://doi.acm.org/10.1145/1168987.1169018
5. Brady, E.: Using social microvolunteering to answer visual questions from blind users. SIGACCESS Access. Comput. **111**, 26–29 (2015). http://doi.acm.org/10.1145/2809904.2809910
6. Brewer, R., Morris, M.R., Piper, A.M.: "Why would anybody do this?" Older adults' understanding of and experiences with crowd work. In: Proceedings of the SIGCHI Conference on Human Factors in Computing Systems, CHI 2016 (2016)
7. Dardailler, D.: The ALT-server ("An eye for an alt") (1997). https://www.w3.org/WAI/altserv.htm
8. DiMicco, J., Millen, D.R., Geyer, W., Dugan, C., Brownholtz, B., Muller, M.: Motivations for social networking at work. In: Proceedings of the 2008 ACM Conference on Computer Supported Cooperative Work, pp. 711–720. ACM (2008)
9. Ellison, N.B., et al.: Social network sites: definition, history, and scholarship. J. Comput.-Mediated Commun. **13**(1), 210–230 (2007)
10. Goncalves, J., Kostakos, V., Hosio, S., Karapanos, E., Lyra, O.: IncluCity: using contextual cues to raise awareness on environmental accessibility. In: Proceedings of the 15th International ACM SIGACCESS Conference on Computers and Accessibility, p. 17. ACM (2013)
11. Hara, K., Azenkot, S., Campbell, M., Bennett, C.L., Le, V., Pannella, S., Moore, R., Minckler, K., Ng, R.H., Froehlich, J.E.: Improving public transit accessibility for blind riders by crowdsourcing bus stop landmark locations with google street view: an extended analysis. ACM Trans. Accessible Comput. (TACCESS) **6**(2), 5 (2015)
12. Holone, H., Misund, G.: People helping computers helping people: navigation for people with mobility problems by sharing accessibility annotations. In: Miesenberger, K., Klaus, J., Zagler, W.L., Karshmer, A.I. (eds.) ICCHP 2008. LNCS, vol. 5105, pp. 1093–1100. Springer, Heidelberg (2008)
13. Holton, B.: A Review of the TapTapSee, CamFind, and Talking Goggles Object Identification Apps for the iPhone (2013). http://www.afb.org/afbpress/pub.asp?DocID=aw140704
14. Howe, J.: The rise of crowdsourcing. Wired Mag. **14**(6), 1–4 (2006)
15. Irani, L.C., Silberman, M.S.: Turkopticon: interrupting worker invisibility in amazon mechanical turk. In: Proceedings of the SIGCHI Conference on Human Factors in Computing Systems, CHI 2013, NY, USA, pp. 611–620. ACM, New York (2013). http://doi.acm.org/10.1145/2470654.2470742
16. Ishihara, T., Itoko, T., Sato, D., Tzadok, A., Takagi, H.: Transforming Japanese archives into accessible digital books. In: Proceedings of the 12th ACM/IEEE-CS Joint Conference on Digital Libraries, pp. 91–100. ACM (2012)
17. Kim, Y., Lee, W.N.: Networking for philanthropy: increasing volunteer behavior via social networking sites. Cyberpsychology, Behav. Soc. Network. **17**(3), 160–165 (2014)

18. Kittur, A., Chi, E.H., Suh, B.: Crowdsourcing user studies with mechanical turk. In: Proceedings of the SIGCHI Conference on Human Factors in Computing Systems, pp. 453–456. ACM (2008)
19. Kobayashi, M., Arita, S., Itoko, T., Saito, S., Takagi, H.: Motivating multi-generational crowd workers in social-purpose work. In: Proceedings of the 18th ACM Conference on Computer Supported Cooperative Work and Social Computing, pp. 1813–1824. ACM (2015)
20. Lasecki, W.S., Thiha, P., Zhong, Y., Brady, E., Bigham, J.P.: Answering visual questions with conversational crowd assistants. In: Proceedings of the 15th International ACM SIGACCESS Conference on Computers and Accessibility, ASSETS 2013, NY, USA, pp. 18:1–18:8. ACM, New York (2013). http://doi.acm.org/10.1145/2513383.2517033
21. Miura, T., Yabu, K.i., Sakajiri, M., Ueda, M., Suzuki, J., Hiyama, A., Hirose, M., Ifukube, T.: Social platform for sharing accessibility information among people with disabilities: evaluation of a field assessment. In: Proceedings of the 15th International ACM SIGACCESS Conference on Computers and Accessibility, ASSETS 2013, NY, USA, pp. 65:1–65:2. ACM, New York (2013). http://doi.acm.org/10.1145/2513383.2513391
22. Miura, T., Yabu, K., Sakajiri, M., Ueda, M., Hiyama, A., Hirose, M., Ifukube, T.: Evaluation of crowdsourced accessibility information sharing. J. Technol. Persons Disabil. **3**, 232–245 (2015)
23. Neudecker, C., Tzadok, A.: User collaboration for improving access to historical texts. Liber Q. **20**(1), 119–128 (2010)
24. Qu, Y., Huang, C., Zhang, P., Zhang, J.: Microblogging after a major disaster in China: a case study of the 2010 Yushu earthquake. In: Proceedings of the ACM 2011 Conference on Computer Supported Cooperative Work, CSCW 2011, NY, USA, pp. 25–34. ACM, New York (2011). http://doi.acm.org/10.1145/1958824.1958830
25. Quinn, A.J., Bederson, B.B.: Human computation: a survey and taxonomy of a growing field. In: Proceedings of the SIGCHI Conference on Human Factors in Computing Systems, CHI 2011, NY, USA, pp. 1403–1412. ACM, New York (2011). http://doi.acm.org/10.1145/1978942.1979148
26. Takagi, H., Kawanaka, S., Kobayashi, M., Itoh, T., Asakawa, C.: Social accessibility: achieving accessibility through collaborative metadata authoring. In: Proceedings of the 10th International ACM SIGACCESS Conference on Computers and Accessibility, pp. 193–200. ACM (2008)
27. Takagi, H., Kawanaka, S., Kobayashi, M., Sato, D., Asakawa, C.: Collaborative web accessibility improvement: challenges and possibilities. In: Proceedings of the 11th International ACM SIGACCESS Conference on Computers and Accessibility, pp. 195–202. ACM (2009)
28. Tarkiainen, M., Back, A., Hulkkonen, J., Konkkola, K.: Crowdsourcing accessibility related information from POI-destinations in Finland. In: 18th ITS World Congress (2011)