# CAMPUS: A University Crowdsourcing Platform for Reporting Facility, Status Update, and Problem Area Information


Chih-Chi Chung
chcchung.cs08@nycu.edu.tw
National Yang Ming Chiao Tung University
Hsinchu, Taiwan, Taiwan

Yen-Chun Lin
barney0817.cs10@nycu.edu.tw
National Yang Ming Chiao Tung University
Hsinchu, Taiwan, Taiwan

Yu-Cheng Wang
ycwong.sc09@nycu.edu.tw
National Yang Ming Chiao Tung University
Hsinchu, Taiwan, Taiwan

Tze-Yu Chen
alexchen.ms07@nctu.edu.tw
National Yang Ming Chiao Tung University
Hsinchu, Taiwan, Taiwan

Chia-Yu Chen
kallechen.cs07@nycu.edu.tw
National Yang Ming Chiao Tung University
Hsinchu, Taiwan, Taiwan

Xin-Ye Jiang
jiangxin.en06@nycu.edu.tw
National Yang Ming Chiao Tung University
Hsinchu, Taiwan, Taiwan

Fang-Yu Lin
emilylin3130.hs07@nycu.edu.tw
National Yang Ming Chiao Tung University
Hsinchu, Taiwan, Taiwan

Yu-Hao Weng
tonywon.cs08@nycu.edu.tw
National Yang Ming Chiao Tung University
Hsinchu, Taiwan, Taiwan

Yung-Ju Chang*
armuro@nycu.edu.tw
National Yang Ming Chiao Tung University
Hsinchu, Taiwan, Taiwan



## ABSTRACT

This paper presents CAMPUS, a crowdsourcing platform that enables its users to report and view information about a university's facilities, real-time status, and problem areas via a mobile web app. The results of our preliminary evaluation indicate that this platform had the potential to inform them about its focal topics, and that they would be motivated to use it if it were deployed on a larger scale. However, the study also highlighted the challenge of dealing with users' mutually redundant reports. Nevertheless, CAMPUS exhibits a strong potential for enabling individuals on a campus to collaboratively inform each other about campus-related information; and our future work will show how individuals on campus leverage this system on a daily basis.



## CCS CONCEPTS

• **Information systems** → **Crowdsourcing**.

## KEYWORDS

crowdsourcing; mobile crowdsourcing; campus; GIS

**ACM Reference Format:**
Chih-Chi Chung, Yen-Chun Lin, Yu-Cheng Wang, Tze-Yu Chen, Chia-Yu Chen, Xin-Ye Jiang, Fang-Yu Lin, Yu-Hao Weng, and Yung-Ju Chang. 2022. CAMPUS: A University Crowdsourcing Platform for Reporting Facility, Status Update, and Problem Area Information . In *Companion Computer Supported Cooperative Work and Social Computing (CSCW'22 Companion), November 8–22, 2022, Virtual Event, Taiwan.* ACM, New York, NY, USA, 4 pages. https://doi.org/10.1145/3500868.3559447



*Corresponding author.





*CSCW'22 Companion, November 8–22, 2022, Virtual Event, Taiwan*





ACM ISBN 978-1-4503-9190-0/22/11.
https://doi.org/10.1145/3500868.3559447


## 1 INTRODUCTION

Crowdsourcing has become a popular method for collecting data, and as smartphones have become more popular, people are increasingly able to perform crowdsourcing tasks on the go: for example, via Google's Crowdsource[1] mobile app [3]. Research has shown that workers are willing to perform such tasks at breakpoints in their normal routines [4]. Volunteered geographic information(VGI) [7] has emerged as a mobile-crowdsourcing domain that is particularly appealing to mobile users and researchers alike, with applications including but not limited to tourism [2], public safety [6, 15], disaster response [17], and dealing with the complexities of built-up environments [1, 12, 16] including campuses [8]. OpenStreetMap(OSM)[2], for example, is an open-sourced map system that allows users to add location-related elements to it, and has been leveraged in commercial (e.g., MapBox[3]) and non-profit projects [11, 13, 14, 17]. Among the diverse sites of these VGI projects, campuses are among the most popular with researchers, who have assigned their participants tasks including seat-capacity/availability checks [5, 8], queue-length estimation [8], environment and hygiene tracking [8], provision of lost-and-found information [9], and security patrolling [15], among others. However, a key limitation of these projects is that they have allowed their participants either to report static information (e.g., about facilities [11, 13, 16]) or to provide real-time status updates about specific locations (e.g. [2, 5, 8, 15]), but not both. As such, the previously devised research apps would not be able to fulfill the varied information needs of all of its potential campus user/interest groups.

[1] https://crowdsource.google.com/.
[2] https://www.openstreetmap.org/.
[3] https://www.mapbox.com/.

To redress that problem, we are developing the Crowd-Assisted Map Pervasive University Service (CAMPUS), a platform that enables reporting of both static facilities information and dynamic status updates. In addition, it also enables reporting of problem areas on campus. In building this platform, we have recruited two waves of 10 student participants to use CAMPUS to, including reporting about facilities [11, 13, 16], providing real-time status updates [5, 8], and flagging problem areas [10, 12, 16]. In the event, these participants shared a variety of static and dynamic information on CAMPUS as well as problem areas that they hoped the university service would address in the future. Qualitatively, they anticipated the benefits they will obtain after CAMPUS has more users on it and reported motivations and incentives for continuing to use the system. Our results also identified challenges that the system needs to address, the most common being reducing redundant reports about the same location being created by different individual users, which were burdensome to view and update. The participants also had some suggestions for how the platform could complement other systems in the future.

## 2 CAMPUS, CROWD-ASSISTED MAP PERVASIVE UNIVERSITY SERVICE

The main page of the CAMPUS system (Fig. 1) shows a campus map, on which each pin (Fig. 1a) represents a report created by a contributor. A search bar (Fig. 1b) is provided to enable users to find their target location, and a "My location" button (Fig. 1c) allows them to focus in on where they currently are. A filter (Fig. 1d) enables them to view specific subsets of pins. Lastly, a "Report" button (Fig. 1e) for initiating the reporting process.

The types of static and dynamic information users can report on CAMPUS were determined based on the findings of previous campus-related crowdsourcing projects [5, 8, 11] as well as discussions within the research team. The three information categories that users can report on CAMPUS are as follows.

- Facilities (Static) (Fig. 2(I)): Users report states of facilities such as bus stops and accessibility of campus services. They can set the states as "true" if the target facilities exist at the specified location, or "false" if they do not.
- Status Update (Dynamic) (Fig. 2(II)): Users report time-sensitive information at a specific location, such as how crowded a restaurant is, or how its WiFi signal strength is. When reporting or updating, users choose an option from a predefined list of status that best describes the situation.
- Problem Area (Fig. 2(III)): Users report issues that need to be addressed, such as standing water, blocked roads, etc, and further update such statuses as being "Unresolved", "Pending" or "Resolved." To determine whether an issue has been resolved, users are asked to vote for each report in the "Resolved" state, and once votes in favor of its correctness exceed a threshold (e.g., 50%), the report will be automatically archived.

We built a responsive web design (RWD)[4] web app based on the React framework[5] to enable our participants to explore and update content on any device. Figure 3 depicts the overall architecture of CAMPUS. We used Google maps[6] to display the campus facilities with user-generated information superimposed, and Geocoding API[7] to extract locations' names. The system was hosted on Firebase[8]. We used GraphQL to connect the front-end interface with the back-end service, and the Apollo GraphQL[9] server was deployed on the GCP cloud run[10] service.

## 3 PRELIMINARY STUDY

We have recruited two waves of student system-evaluation participants to use CAMPUS for one semester. The first was from October 2021 to January 2022 (10 undergraduate students), and the second is ongoing, starting from April 2022 (10 undergraduate students). Two interviews were conducted with each student participant. To maximize their experience of using the platform and thus derive richer insights from their feedback, we instructed them to perform at least 50 activities on it, including adding, updating, and viewing reports, and to ensure that the latter category amounted to less than half of all their activities. Table 1 shows the reports created by the first-wave students. They created a total of 177 reports, of which 42.9% were facilities reports, 40.1% were status updates, and 17% were problem areas. The top focus of facilities reports was accessible ramps, and of status updates, restaurants. Table 2 shows the number of actions performed by these students during this period. They mostly viewed the point (84.62%) compared to added point (7.73%) and updated status in the point (7.65%). Since students in the second-wave have not completed their participation, their data is not included. However, Figure 4 shows various examples of problem areas that these students reported on CAMPUS, including access blocked by broken floors, water puddles, and repair work, as well as hygiene problems.

**Table 1: Points created, by type**

| Category | Report, n | % |
|---|---|---|
| Facilities | 76 | 42.9 |
| Dynamic | 71 | 40.1 |
| Problem Areas | 30 | 17 |
| Total | 177 | 100 |

**Table 2: Number of actions taken, by type**

| Actions | Actions, n | % |
|---|---|---|
| Add a Point | 177 | 7.7 |
| Update Status about an Existing Point | 175 | 7.7 |
| View a Point | 1,937 | 84.6 |
| Total | 2,289 | 100 |

[4]https://web.dev/responsive-web-design-basics/.
[5]https://reactjs.org/.
[6]https://www.google.com/maps.
[7]https://developers.google.com/maps/documentation/geocoding.
[8]https://firebase.google.com/.
[9]https://www.apollographql.com/.
[10]https://cloud.google.com/run.

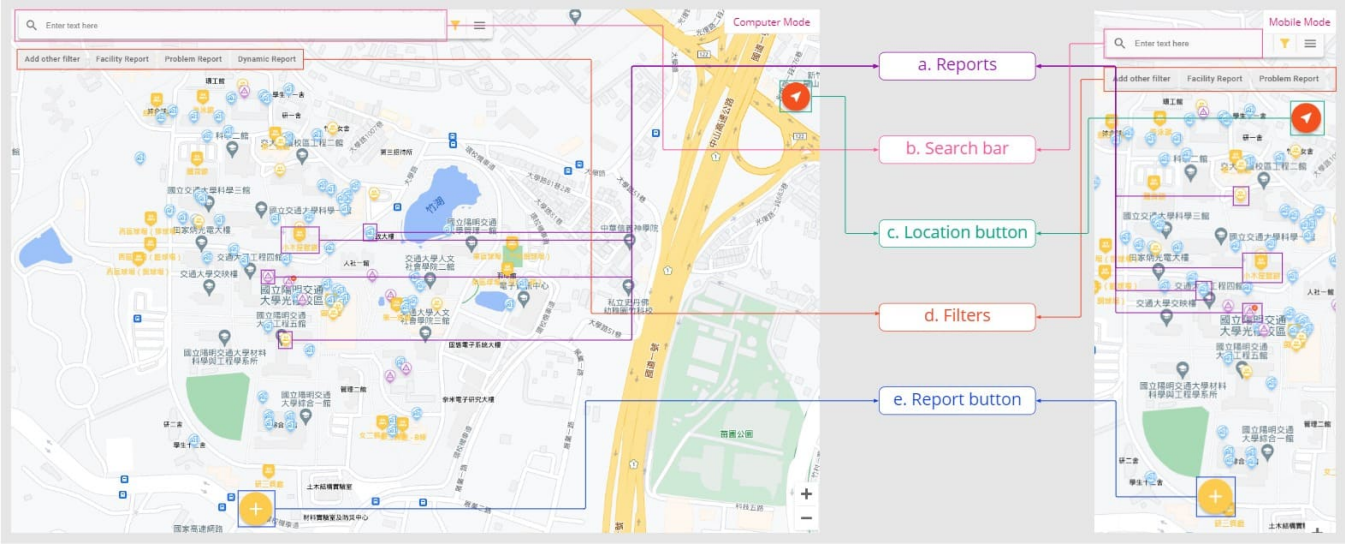


**Figure 1: Mobile and PC versions of the CAMPUS home page.**

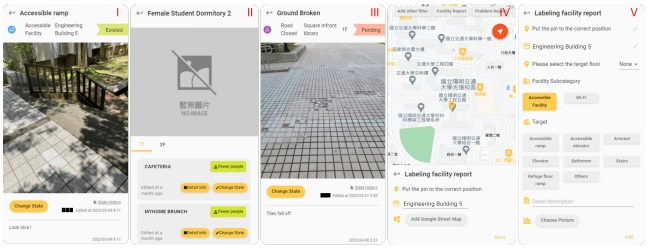

**Figure 2: I: Facility report. II: Dynamic report. III: Problem report. IV, V: Report process.**

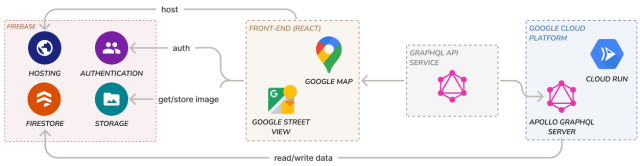


**Figure 3: Platform architecture of CAMPUS, designed using Figma. Icons in the box at the far left appear courtesy of Firebase.**

Overall, the student users of CAMPUS appreciated being able to share and explore information on the platform. As P7 commented, *"I may want to get some drinking water when I have a class in an unfamiliar building, and could use this platform to find where the closest water dispenser is."* Some students reported that when they encountered problems including crowdedness on the campus, they liked reporting them on CAMPUS, but sometimes forgot to do so. As P5 explained: *"One time when I encountered a broken floor, I remembered that I could report the problem on CAMPUS. However, sometimes I forgot to report the crowdedness status of the restaurant. I think to help me develop a habit of reporting, the system needs to provide me with some incentives."* When reflecting on what possible incentives could attract them to use this platform ongoingly, some participants mentioned virtual points that allowed them to exchange stickers, badges, or coupons that could be used in stores or to pay for other services on campus. For example, P1 said, *"It'd be terrific if I could get points to use Oloo*[11] *as an incentive."*

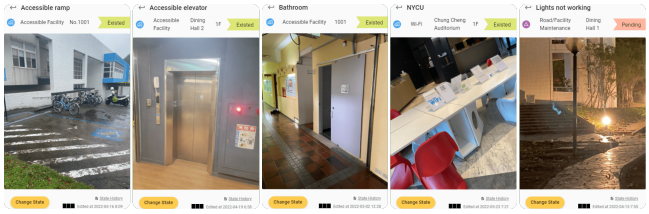

**Figure 4: Participants' reports about various issues they hoped the university administration would repair or otherwise address.**

The participants also reported challenges to using CAMPUS. One was related to frequently visited areas that received many reports from them collectively, some of which reported redundant information. Such areas were subject to multiple pinning, resulting in large numbers of pin icons and making it difficult for participants to view and update specific reports. For example, P9 commented, *"There are a lot of pins in this area. They are all talking about the same thing, but were created by different people. [...] I need to click every pin in the area to know exactly what the information is about these points."* This was because of participants' tendency to add new reports without first checking whether the same information already existed on the map. Some participants also wished CAMPUS to include additional types of reports and allow direct notification of the university administration about problem areas, as P8 commented *"if CAMPUS*

[11] https://www.oloo.com.tw/.

*could be integrated with the existing repair-management system, it would tell the administration office where to find damage."*

## 4 FUTURE WORK AND CONCLUSION

This paper has presented a crowdsourcing platform, CAMPUS, that allows people to report, update, and view both dynamic and static information about their university campus. The results of our preliminary user study suggest that the system has a strong potential to benefit them, and that this benefit is likely to increase as more users and features are added. On the other hand, they also highlighted challenges that this location-based crowdsourcing platform should address, such as that the reports they made can be directly delivered by the app to the relevant university office. We agree that this would give contributors to CAMPUS a sense of accomplishment and that their contributions are having an impact, though more direct incentives such as points redeemable in campus stores may also be necessary, at least initially, if the system is to achieve wide acceptance.

## ACKNOWLEDGMENTS

This research was supported in part by the National Science and Technology Council, R.O.C (110-2221-E-A49 -164-). We thank the help from Yin-Hsiang Chang.

## REFERENCES

[1] Francesco Calabrese, Massimo Colonna, Piero Lovisolo, Dario Parata, and Carlo Ratti. 2011. Real-Time Urban Monitoring Using Cell Phones: A Case Study in Rome. *IEEE Transactions on Intelligent Transportation Systems* 12, 1 (March 2011), 141–151. https://doi.org/10.1109/TITS.2010.2074196

[2] Yung-Ju Chang, Chu-Yuan Yang, Ying-Hsuan Kuo, Wen-Hao Cheng, Chun-Liang Yang, Fang-Yu Lin, I-Hui Yeh, Chih-Kuan Hsieh, Ching-Yu Hsieh, and Yu-Shuen Wang. 2019. Tourgether: Exploring Tourists' Real-time Sharing of Experiences as a Means of Encouraging Point-of-Interest Exploration. *Proceedings of the ACM on Interactive, Mobile, Wearable and Ubiquitous Technologies* 3, 4 (Dec. 2019), 128:1–128:25. https://doi.org/10.1145/3369832

[3] Pei-Yu (Peggy) Chi, Anurag Batra, and Maxwell Hsu. 2018. Mobile Crowdsourcing in the Wild: Challenges from a Global Community. In *Proceedings of the 20th International Conference on Human-Computer Interaction with Mobile Devices and Services Adjunct (MobileHCI '18)*. Association for Computing Machinery, Barcelona, Spain, 410–415. https://doi.org/10.1145/3236112.3236176

[4] Chia-En Chiang, Yu-Chun Chen, Fang-Yu Lin, Felicia Feng, Hao-An Wu, Hao-Ping Lee, Chang-Hsuan Yang, and Yung-Ju Chang. 2021. "I Got Some Free Time": Investigating Task-execution and Task-effort Metrics in Mobile Crowdsourcing Tasks. In *Proceedings of the 2021 CHI Conference on Human Factors in Computing Systems (CHI '21)*. Association for Computing Machinery, New York, NY, USA, 1–14. https://doi.org/10.1145/3411764.3445477

[5] Kapil Garg, Yongsung Kim, Darren Gergle, and Haoqi Zhang. 2019. 4X: A Hybrid Approach for Scaffolding Data Collection and Interest in Low-Effort Participatory Sensing. *Proceedings of the ACM on Human-Computer Interaction* 3, CSCW (Nov. 2019), 90:1–90:28. https://doi.org/10.1145/3359192

[6] Allan Goncalves, Carlos Silva, Patricia Morreale, and Jason Bonafide. 2014. Crowdsourcing for Public Safety. In *2014 IEEE International Systems Conference Proceedings*. 50–56. https://doi.org/10.1109/SysCon.2014.6819235

[7] Michael F. Goodchild. 2007. Citizens as Sensors: The World of Volunteered Geography. *GeoJournal* 69, 4 (Aug. 2007), 211–221. https://doi.org/10.1007/s10708-007-9111-y

[8] Thivya Kandappu, Archan Misra, Shih-Fen Cheng, Nikita Jaiman, Randy Tandriansyah, Cen Chen, Hoong Chuin Lau, Deepthi Chander, and Koustuv Dasgupta. 2016. Campus-Scale Mobile Crowd-Tasking: Deployment & Behavioral Insights. In *Proceedings of the 19th ACM Conference on Computer-Supported Cooperative Work & Social Computing (CSCW '16)*. Association for Computing Machinery, San Francisco, California, USA, 800–812. https://doi.org/10.1145/2818048.2819995

[9] Yongsung Kim, Emily Harburg, Shana Azria, Aaron Shaw, Elizabeth Gerber, Darren Gergle, and Haoqi Zhang. 2016. Studying the Effects of Task Notification Policies on Participation and Outcomes in On-the-go Crowdsourcing. *Proceedings of the AAAI Conference on Human Computation and Crowdsourcing* 4 (Sept. 2016), 99–108.

[10] Stephen F. King and Paul Brown. 2007. Fix My Street or Else: Using the Internet to Voice Local Public Service Concerns. In *Proceedings of the 1st International Conference on Theory and Practice of Electronic Governance (ICEGOV '07)*. Association for Computing Machinery, New York, NY, USA, 72–80. https://doi.org/10.1145/1328057.1328076

[11] Mohamad Afi Asyraf Maidin, Faridahanim Ahmad, Nur IzieAdiana Abidin, Jauziah Suhaili, Mariah Awang, Mohammad Ashraf Abdul Rahman, Mohd Kamaruzaman Musa, Nuramidah Hamidon, Fatimah Mohamed Yusop, M. M. Syafiq Syazwan, Hasnida Harun, Nor Hazren Abdul Hamid, and Nur Atikah Kamil. 2021. Design Campus Map Using OpenStreetMap Digital Software. In *Proceedings of the 3rd International Conference on Separation Technology (Lecture Notes in Mechanical Engineering)*, Muhammad Abbas Ahmad Zaini, Mazura Jusoh, and Norasikin Othman (Eds.). Springer, Singapore, 113–129. https://doi.org/10.1007/978-981-16-0742-4_8

[12] Nicolas Maisonneuve, Matthias Stevens, and Bartek Ochab. 2010. Participatory Noise Pollution Monitoring Using Mobile Phones. *Information Polity* 15, 1-2 (Jan. 2010), 51–71. https://doi.org/10.3233/IP-2010-0200

[13] Amin Mobasheri, Jonas Deister, and Holger Dieterich. 2017. Wheelmap: The Wheelchair Accessibility Crowdsourcing Platform. *Open Geospatial Data, Software and Standards* 2, 1 (Nov. 2017), 27. https://doi.org/10.1186/s40965-017-0040-5

[14] Peter Mooney and Padraig Corcoran. 2012. The Annotation Process in OpenStreetMap. *Transactions in GIS* 16, 4 (2012), 561–579. https://doi.org/10.1111/j.1467-9671.2012.01306.x

[15] Sangkeun Park, Sujin Kwon, and Uichin Lee. 2018. CampusWatch: Exploring Communitysourced Patrolling with Pervasive Mobile Technology. *Proceedings of the ACM on Human-Computer Interaction* 2, CSCW (Nov. 2018), 134:1–134:25. https://doi.org/10.1145/3274403

[16] Manaswi Saha, Kotaro Hara, Jon Froehlich, Michael Saugstad, Hanuma Teja Maddali, Aileen Zeng, Ryan Holland, Steven Bower, Aditya Dash, Sage Chen, and Anthony Li. 2019. Project Sidewalk: A Web-based Crowdsourcing Tool for Collecting Sidewalk Accessibility Data At Scale. In *Proceedings of the 2019 CHI Conference on Human Factors in Computing Systems - CHI '19*. ACM Press, Glasgow, Scotland Uk, 1–14. https://doi.org/10.1145/3290605.3300292

[17] Matthew Zook, Mark Graham, Taylor Shelton, and Sean Gorman. 2010. Volunteered Geographic Information and Crowdsourcing Disaster Relief: A Case Study of the Haitian Earthquake. *World Medical & Health Policy* 2, 2 (2010), 7–33. https://doi.org/10.2202/1948-4682.1069