Office of Institutional Research and Social Responsibility, NTU
International Degree Program in Climate Change and Sustainable Development, NTU
Research Center for Future Earth, NTU

NEWSLETTER
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SC+NTU

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SC+NTU Work Team

In response to the cascade of issues such as climate change, economic development, a growing wealth gap and social equality, in 2015 the United Nations published "Transforming our World: the 2030 Agenda for Sustainable Development." The agenda proposed 17 Sustainable Development Goals (SDGs), including mitigation of climate change, eradication of poverty, eradication of hunger, promotion of equal rights, etc., to help provide countries, economies, companies, groups, and individuals a clearer direction toward sustainable development. Among them, the 11th goal is to "build cities and villages that are inclusive, safe, resilient and sustainable." The reasoning behind this goal is that along with rapid planetary urbanization, there is a corresponding increase in urban population. According to a UN prediction, two-thirds of the world's population will live in cities by the year 2050. Addressing this trend has become critical since it is also deeply intertwined with climate change, inequality, and the root causes of economic and social issues. The field implementation of SC+ is located in the core area of the Greater Taipei Metropolitan Area. The plan itself starts from the comfort of the environment. Many project aims are directly linked to SDG11, and at the same time, they endeavor to solve additional problems observed in the urban environment. The results section of this month's newsletter will introduce the simulation analysis of the open sky over NTU, as well as the automation of NTU4AQ sensor monitoring and abnormal reporting; while Comfort + Common Sense will answer the question: what is a smart city? This section will then also share five concerns of scholars about smart cities.

Monthly Activities Summary

07/01

First Meeting with the Summer Interns

IPCS has recruited interns this summer, including four student advisors whose research interests are closely related those of the SC+ programs. Therefore, the SC+ team held the first meeting on this day for a preliminary discussion on summer research topics with Professors Chien Shiuh-Shen, Lin Po-Hsiung, Juang Jehn-Yih, and Hsieh Yi-Huan. The interns come from diverse backgrounds; including business administration, biomechanics, liberal arts, urban planning and other departments. But they all came to IPCS for summer research with enthusiasm for environmental sustainability research, so we look forward to the exciting new sparks that are coming soon!

07/13

MAPS6 Back to Back Hugs

This summer, the SC+ team embarked on mobile monitoring projects, which were mainly conducted with MAPS6 microsensors. However, when we are conducting monitoring, especially long-term mobile monitoring, such as the marathon route, we found that the instrument settings are slightly different in different situations, which may depend on variance in sun exposure. Therefore, the MAPS test of the sun is hereby launched. With the test results, whether through institutional modification or location change, we hope to achieve the best measurement method for a mobile MAPS6 to monitor outdoors. Look forward to a fresh new look of MAPS6 in the future!

07/20

Ministry of Education “University Social Responsibility” Activities

The Center for University Social Responsibility, run by the Ministry of Education, organizes events for sharing experiences and training in University Social Responsibility (USR). This time, Kaohsiung Medical University shared their experience assisting local community medical care and education of the Namatha tribe. This experience highlighted the important role that the university plays in the local community. In addition, Tamkang University also shared its efforts in international rural education in Cambodia, which helped spotlight Taiwan on the international stage. Our own NTU SC+ team shared our deep engagement in the use of technology to sense environmental values, observe local data, and promote community environmental awareness and climate action.

07/28

IPCSxCWB Climate Services Workshop

IPCS and CWB (Central Weather Bureau) jointly organized the first workshop on climate services. Representatives from NTU’s departments of Atmospheric Sciences, Geography, Biomechatronics Engineering, the Yunlin Branch of NTU Hospital were all invited, as well as representatives from the Bureau of Meteorology, Youth Climate Alliance (TWYCC), NTU Sustainability Department, and the SC+ team. The discussions covered a variety of topics, including the possibility of various issues in climate services, dealing with questions of spatio-temporal scale, gaining a deeper understanding of current technologies and shortages, and hoping to add vitality to efforts promoting the climate service industry.

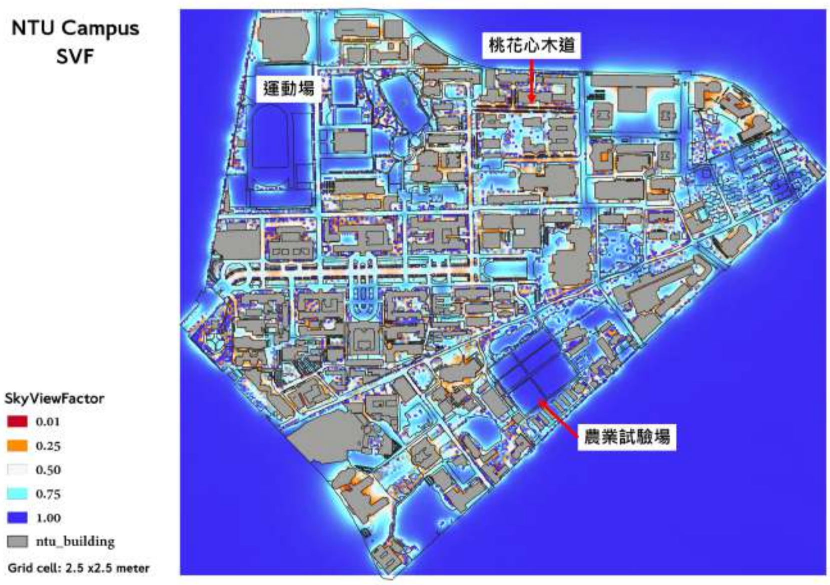
Achievements and Announcements

QGIS simulation analysis of the openness of the sky at NTU

SC+ Work Team and IPCS Rong-Cih, Chang

The sky view factor (SVF) analysis is based on the method proposed by Yokohama (2002) to calculate the horizon openness problem. Sky openness is the proportion of the sky visible from the ground and is closely related to the amount of insolation the plane receives. The sky openness factor is between 0 and 1, a value of 1 means the sky is fully visible, such as in the middle of an open field; when there are buildings or trees around the measurement point, it will cause the SVF scale to decrease. This time, the sky openness calculator in the extrapolation package UMEP of QGIS is used to simulate the sky openness of the National Taiwan University campus. This package only needs to input the digital surface model (DSM) of the building and the surface to calculate the sky openness. However, trees are also an important factor that affect the openness of the sky. Since the crown width of trees is an element that affects openness, the team members measured the crown widths on campus and found that the difference in the crown width of different tree species, such as broad-leaved trees and conifers, can reach 4%. (The radius of conifer canopy is 1 meter, and the radius of broad-leaved tree canopy is 4 meters); since the campus is mostly broad-leaved trees, the tree point data in the campus is used to conduct a buffer with a radius of 3 meters as the tree. The crown width range was imported into the campus tree map provided by the Department of Civil Engineering (about 10,000 points of data). The data records the height of each tree, so in this instance the campus tree is assumed to be a cylinder 3 meters in radius whose height is input according to actual measured data, and after merging with the building DSM, the grid model with a grid of 2.5 x 2.5 meters is exported, and then finally imported to the sky openness calculator for simulation.

The simulation results are shown in Figure 1 below, which shows that the Mahogany Road (Fisheries Science Museum, Foreign Language Teaching and Resource Center, Computer and Network Resource Center) is the least open road on the NTU campus. It is full of mahogany trees, the height which can reach 10 meters. The width of the road is only 10 meters. Therefore, when the crown radius is 3 meters and the tree height is 10 meters, the sky opening here has a value of only 0.23 , which is the least open road on campus. The most open areas on the campus are the sports field and the agricultural test field. Because the surface height is 0 meters, and there are few buildings and trees around, the sky openness value of these two places is close to 1.



Figure(1) Sky Openness Map of the NTU

Then, the 17 NTU4AQ points in the school and the sky openness layer are overlapped and analyzed, and the statistical analysis is carried out with the values calculated by using the Sky Openness after capturing data with the fisheye camera at each point (the values are as shown in Table 1 below), the statistical results in Figure 2 below show that the QGIS simulation results have a positive correlation with the sky openness captured by the actual fisheye (the slope is 0.8), and the correlation coefficient reaches 0.71, which is highly correlated. After comparing the points, it is found that the simulation results of QGIS are overestimated at the agricultural test site, the NTU entrance, the old building, the new building, the general map, and the slightly saturated points. After discussing with the team members, since the NTU4AQ is installed on a utility pole or street lamp, the street lamp cover will also affect the sky opening obtained by the fisheye shooting. In addition, the NTU4AQ is erected at a height of 2 meters, so if the surrounding trees are lower than 2 meters, the shading effect on the NTU4AQ is not large, and this simulation assumes that each tree is the same cylinder, which is also the difference between the impact and the measured value. Therefore, the DSM height data in this instance must be reduced by 2 meters for simulation, and different radius assumptions are made for the crown width of different tree species, and then statistical analysis is carried out with the measured values.

Table (1) Measured and simulated values of sky openness at each point of NTU4AQ on campus

Location	Cnpy Open(%)	SVF_QGIS(%)
大氣草坪	93.92	90.53
運動場	86.58	97.04
管院停車場	83.56	97.16
傅鐘	79.47	84.83
農業試驗場	77.47	94.78
台大門口	74.29	56.43
舊體	73.18	98.54
總圖	69.63	91.22
醉月湖(IPCS)	68.47	54.74
小福	63.9	75.27
醉月湖(天數館)	58.48	55.75
新體	55.96	74.68
小小福	52.26	53.5
社科院旁外教中心	46.32	60.33
鄭江樓	44.08	54.8
醉月湖(稍飽)	43.71	78.94
女九	39.88	41.44
湖心亭	未測量	95.56
RMSE	15.8939	

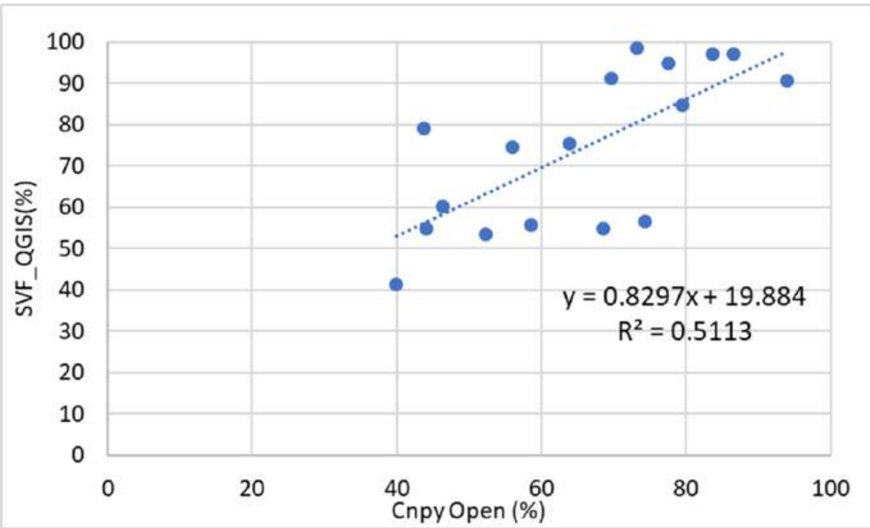


Figure (2) The regression relationship between the measured and simulated values of the NTU4AQ sky openness on campus

Solutions for Sensor Management: Machine Monitoring and Automation of Abnormal Returns

Mr. Kong's team Zhong Jia, Guo

Since it is time-consuming and laborious to manually check whether the machine operating normally, it is hoped that the data returned by the sensor itself can be automatically reported to the management team when the machine is operating abnormally. Moreover, if the machine is temporarily not communicating because of minor problems, and someone is sent out to conduct maintenance, it is also an extra cost. Therefore, it is hoped that an automatic prediction of whether the machine will resume normal operation can be achieved. This management system combines SC+NTU database and LINE bot to automatically monitor machine status, report abnormalities, and predict whether the machine will recover after a brief interruption.

This system will request data from the NTU4AQ database every 15 minutes, and obtain the time for a return data from all machines. The machine will be divided into several states, such as "online, offline", "no response in 22.5 minutes", "no response in 3 hours, 12 hours, 24 hours, and 72 hours" according to the time when the last data is returned. If the machine is "22.5 minutes without response" or "3 hours without response", the system will use the pre-trained model to further predict whether the machine will recover on its own. The management team can also choose to retrain the model with more recent data to achieve better prediction results according to their needs.

After receiving the machine status, the system will enter the records into the database. In the next recheck, if the status of the machine changes, the LINE bot will send a message to the management group. For example, if NTU4AQ_00001 changes from "12 hours no response" to "24 hours no response", or from "24 hours no response" to "online", a message will be sent to the group, so that the management team can know the machine status in real time, and then judge whether or not the machine needs to be flagged for further maintenance or inspection. An example of LINE bot operation is shown in Figure 3.

Figure (3) System operation screen

In terms of system construction, the chosen method is to write the main functions as APIs with Python's Flask framework. There are currently two major functions, the first is the aforementioned module that checks and inputs to the database every 15 minutes. After writing this module as an API, Google Cloud Scheduler can call it every 15 minutes to execute this function on a regular basis. Another feature is that the management team can send messages through the LINE group to check the status of individual or all machines. This portion uses the LINE Messaging API (an API that provides the LINE bot function) to parse the received message, and then asks the NTU4AQ database for the data of the corresponding machine. The system flow of the two functions is summarized in Figure 4.

At present, this system has been used as an internal management tool, and it is expected that in the future, automation and data analysis will provide additional internal management or commercial value.

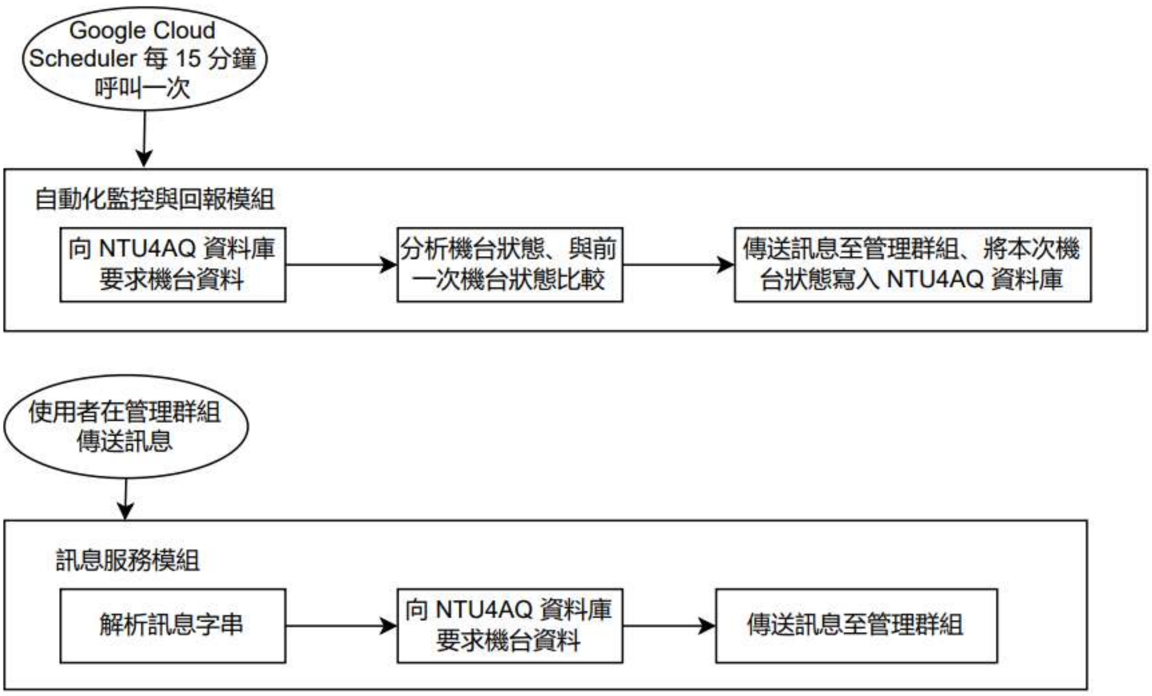


Figure (4) System Architecture Diagram

Science Tips

Five Concerns About Smart Cities

SC+ Work Team and Department of Geography Cheng-En, Lin

The “smart city”, a city connected by various Internet of Things (IoT) and Information and Communication Technology (ICT) devices, has become the development trend of major cities today. This article is mainly excerpted from Robert Kitchin's "The real-time city? Big data and smart urbanism" which raises five concerns about the future of the smart city: (1) the politics of big urban data; (2) technocratic governance and city development; (3) corporatisation of city governance and technology lock-ins; (4) hackable cities; and (5) the panoptic city.

In the past, data was often considered to be neutral, objective, benign, and non-political. The production process of data was based on science rather than ideology. However, any data production cannot exist independently of ideas, technology, science, personnel and the environment. Put another way, the production process is selective and will be screened, and these screening conditions may be determined by ideological systems, tacit knowledge, public and political opinions, ethical considerations, the regulatory environment, and financial resources. For example, the location where the sensors that collect data are to be installed, the bias generated by data collection, what calibration standard to use, and how the data is classified. A lot of data is born under certain political visions, and the production and interpretation of these data will be influenced by the values of specific classes in society or experts in the field, and may ignore the role of others. Therefore, when discussing big data, we should sort out the hidden values behind the data, and further discuss the purpose of these data production and for whom it is produced.

Driven by smart cities, it is often necessary to manage cities through information and analytical systems, which also promote a technocratic model of urban governance. The technocratic model holds that urban problems can be reduced to those which can be indexed or otherwise measured, and eventually solved through relevant technical practices. However, some authors assert that such technocratic thinking is rather narrow, and that such a model ignores the complexity of social issues which may involve dimensions such as culture, politics, policy, governance and capital. This presents a technocratic model that may only optimize or manage superficial challenges, while making it difficult to drill down to lower-level structural problems.

With the development of smart cities, the corporatisation of city governance and resulting technological lock-ins may occur. Smart city engineering requires and incentivizes the development of a wide array of technological solutions. In turn, this allows many businesses to enter the city to provide public services; and it may also have contributed to a neoliberalized political economy and public service market, with many public services being run and profited on by private enterprises. In the process, after a few companies have mastered the key technologies of smart city services, municipal governments enter into a dependent relationship with these firms. The resulting monopoly benefits to the companies result in a so-called technology lock-in. However, the speed of smart city development and technological advancement has been rapid, and when the technology is locked under monopolistic conditions, it may adversely impact the ability to innovate and updates services in the future.

Smart cities hope to provide digital solutions to urban problems, and while the code runs throughout urban space and enables “smart” functionality, it also brings some hidden concerns. Such software services themselves are unstable and relatively easy to manipulate. Malfunctioning, porous, temporary, and when operation fails, it can lead to the disruption of basic urban services. A city composed of code and digital devices is also vulnerable to the threat posed by viruses and hackers, and it is necessary to face this risk of functional collapse in the city and the real costs it poses.

In the past, it was difficult for governments to integrate a large amount of data generated by various agencies. However, with the development of smart technology, various government agencies can achieve horizontal integration, and more unified presentation of real-time data to meet the needs of security and safety. In the example of a data monitoring center, we see the rise of a centralized point of collection and analysis that has a panoramic view of the entire society. While this may achieve security and surveillance goals, it may also stifle the rights of privacy, confidentiality and freedom of expression. Drawing on Michel Foucault's theory of the Panopticon as a prison space design, we can make an analogous case for the smart city. Through a powerful central surveillance tower, the authority can potentially monitor every criminal, but the criminal is blind to the activities of the monitoring tower, and are thus incapable of knowing when they are being observed. The logical solution for the prisoner then, is to self-monitor and self-discipline, enabling the infiltration of centralized power, and an efficient method of managing criminals. This is analogous to the ubiquitous sensing and computing in smart cities, which utilize ICT and IoT devices to record people's lives in the form of data. Such tensions will intensify as all aspects of urban life are increasingly and more accurately described by data. In turn, the challenge of creating a balance between the benefits of data monitoring and the protection of individual and social rights to maintain democracy and trust will likely remain an important issue.

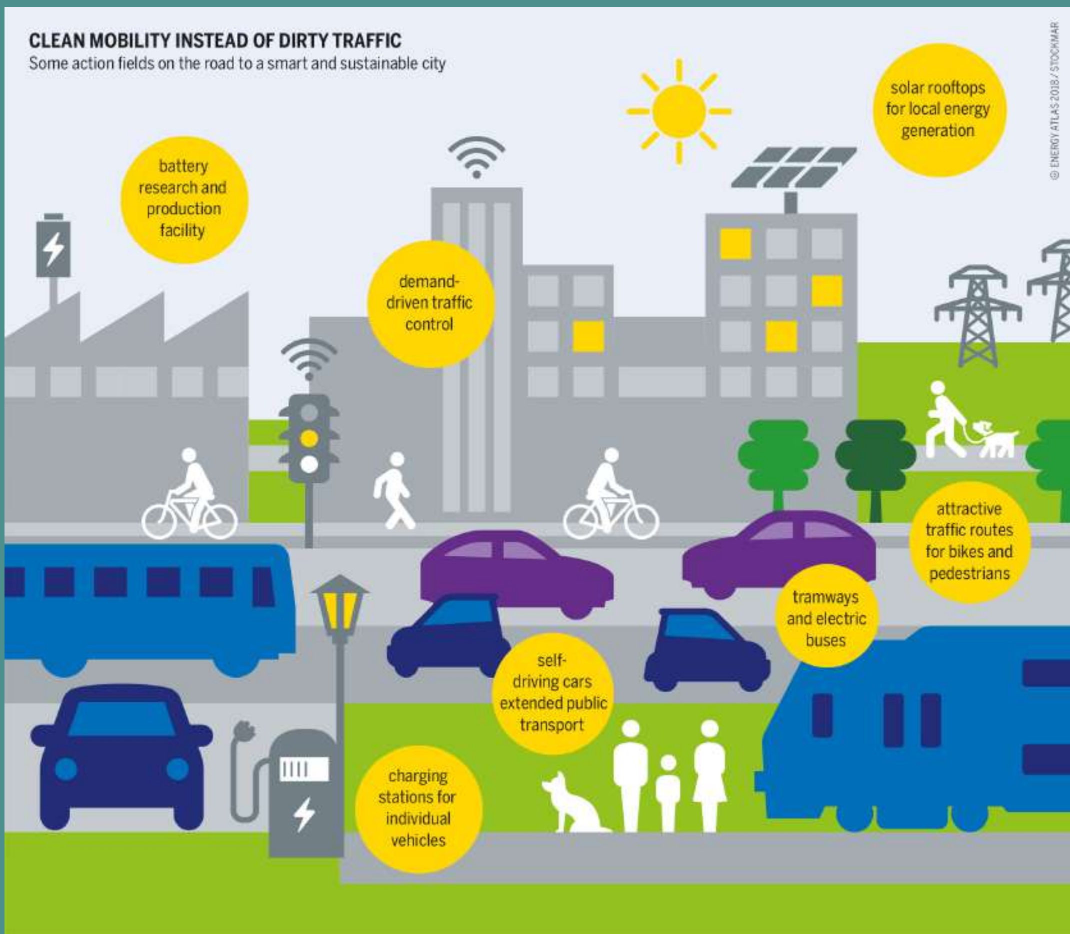


Figure (5)Schematic diagram of Smart City
(Taken from Wikipedia)

References:

1. Kitchin, R. (2014). The real-time city? Big data and smart urbanism. GeoJournal, 79(1), 1-14.

2. https://zh.wikipedia.org/zh-tw/%E6%99%BA%E6%85%A7%E5%9F%8E%E5%B8%82222

ABOUT OUR TEAM

SC+NTU Work Team

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International Degree Program in Climate Change and Sustainable Development (IPCS)

The International Degree Program in Climate Change and Sustainable Development, as its name suggests, is an interdisciplinary degree program that encompasses a global perspective. Established by the College of Science, the program is a joint effort among NTU faculty members from both scientific research and humanities backgrounds. In dealing with climate change and sustainable development, we instrument in-depth teaching in a wide range of topics. Students are required to bring their knowledge and skills to the table and approach environmental issues from a multi-angled perspective. They are encouraged to break free from traditional views on sustainability and think outside the box. Students are expected to be motivated learners, thinkers, analysts, and most important of all, practitioners. Our ultimate goal is to cultivate students' ability in interdisciplinary problem-solving in dealing with the complexity of climate change issues.

ABOUT OUR TEAM

Location Aware Sensing System (LASS)

The Location Aware Sensing System (LASS) is an important maker community in Taiwan, and it is also the creator of air boxes, water boxes, and other micro-sensing devices. LASS focuses on the integration of citizen technology and spatial information, aiming to design and implement an environmental sensing system with local characteristics through the integration of hardware and software. The community strives to promote open source and public welfare as the main axis, and to create customers instilled with a 'self-creator' spirit, develop low-cost environmental monitoring equipment with an open software and hardware architecture so that the public may build a set of sensing systems that meet their specific needs through a self-made process. At the same time, LASS also adopts and open attitude towards sensing data and allows volunteers to use environmental monitoring data uploaded to the cloud system by other partners in the community in order to build a real-time monitoring network.

PARTNERS ➤

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