# Supporting Sustainability and Healthy Learning Environment through Smart Green Management System (SGMS)

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# Supporting Sustainability and Healthy Learning Environment through Smart Green Management System (SGMS)

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**Abstract**. Today, most universities worldwide have initiated the green campus campaign. In line with the campaign intention to sustain and create healthy learning environment, we developed a system, which aims to facilitate the management of recycle program as part of green campus initiative. Smart Green Management System (SGMS) is a mobile crowdsourcing-based system with a capability to help fast-managing and coordinating recycling effort between the green university council and green city council. This system allows access from any mobile devices at anytime and anywhere. Centralized participatory crowdsourcing method is the key approach in developing this system. In this approach, the crowd is tasked with finding and collecting information into a common location and format. It is ideal for information gathering, organization, and reporting problems, which are demonstrated by SGMS.

## 1. Introduction

A green campus is a concept that emphasizes the resource conservation, efficient usage of energy and enhanced quality of environment in the higher learning institution. It simply educating for sustainability and creating healthy learning environment. Our work is very much inspired by the premise that sustainability educates rational use of natural resources in order to preserve the planet for future generations

Today, most universities worldwide have initiated the green campus campaign. Throughout this campaign, various programs have been conducted to promote sustainability and healthy environment. The sky is the limit for this campaign. It means that it caters from litters and waste, to energy, to water conservation and include a day without vehicles, plastic-free day, free public transportation day, earth hour, cleanup day, plant a tree day, recycle and many more.

In line with the campaign intention, we developed a system, which aims to facilitate the management of recycle program as part of green campus initiative. We name this system Smart Green Management System (SGMS) which reflects its capability to help fast-managing and coordinating recycling effort between the green university council and green city council. This system is a web-based system which allows access from any mobile devices at anytime and anywhere and our target users will be the university community especially students residing in the campus. For our study, we

choose University Putra Malaysia (UPM) which comprises of 17 residential colleges with estimated capacity of 17 thousand students. With this huge number of students, we believe our effort and intention is rightly emphasized when a clean and healthy learning environment is mandatory.

The remainder of this paper is organized as follows. Section 2 summarizes some previous works related to our intention. Section 3 explains the SGMS. This is followed by section 4 which discusses briefly our highlight of study. Finally, section 5 presents our conclusion.

## 2. Recycling Management and Technologies

Recycling is one way in reducing the environmental deterioration by managing the waste properly. Although the awareness campaign of recycling repeatedly carried out and consumers' awareness is increase, participations in recycling are still low. Recycling can be define as a process of collecting and processing waste turning into new products that could benefit the community and environment [1].

In Malaysia, national recycling campaign was launched in 1993. However, only 15% of recycling rate was achieved in 2016 [2]. This is far away from the aim for the 2020 national recycling rate set by the Malaysian Government which is 22 % [3]. The 3R program awareness: reuse, reduce and recycle, is still very low among Malaysian. Changing of lifestyle and attitudes are important to achieve the objective.

Respect environmental issues, awareness and fundamental knowledge of recycling as an important stimulus to encourage household in recycle campaign. The emphasis on recycling as a sustainable waste management strategy has taken a shift paradigm towards a change in its implementation. In addition, the efficient recycling of waste is indispensable and still be regarded as a major challenge for today's society. Although the awareness among household is increase, it is often a question on the management of insufficient collection infrastructures and poor collection efficiencies of the waste.

In Malaysia, current approach that usually implements for recyclables collection is presented of recyclables kiosk or establishing collection centers by local authorities, NGOs and private organizations. Another approach is by the private collectors of recyclable that come to the house premises to collect the goods. Mohamad et al. [3] discuss on the role of religious community in Malaysia in the recycling practice and activities that are well-managed and active. One example of successfully waste recycling program based on religious community with the proper management system is at Surau Al-Husna. Although there are required technical improvement in their recycling programs such as a needed of database management for recording the recycling rate and a better storage policy of recyclable items must be implemented, it could serve as a role model for sustainable recycling programs at the nationwide scale in Malaysia [4].

Convenient collection process, together with establishing cost-effective ways to communicate for users are paramount importance for an efficient recycling management. As the information and communication technologies grows, sustainable solutions to the waste and recycling management through the use of real time technologies and IoT (Internet of Things) connectivity also gained significant attention over the past decade. This can be seen with the large number of mobile applications that have been developed for ease of use in waste management. The Recycle Track Systems (RTS) is one example of innovating waste and recycling management that implements real time technologies, IoT connectivity, and accountability that increases efficiency and insight into waste and recycling service pickups. RTS was employed for the customer in New York City by taking picture of the items that needed to be remove and the application will be allocated the approval with price estimation and time schedule for the pickup. Not only for waste removal services but also for contraction and demolition added on for the dumpster order [5]. Many other applications of waste management convenient for mobile user such as iRecycle [6], Recycle App [7] and etc.

Although a lots of application available, data taken from the customer will be value added to be analyzed to improve the management of the system. Exploiting the ICT and Web 2.0 social software is a mechanism that connects people to raise a valuable data to create new forms of distant search for solutions and decision making for environmental application. In order to ensure the convenient

collection process together with establishing cost-effective ways, the idea of crowdsourcing can be implemented in the management of the recycling waste. The digital technologies will be the platform to collect and organise contributions from a crowd such as data, idea, opinions and therefore help in obtain innovative solutions. According to Howe (2006) [8], crowdsourcing can be defined as an open call participation of contributor to produce new content, products or data in the development of creative solutions using the crowdsourcing tools. Crowdsourcing now has been subject of numerous experiments in transforming sustainable cities environment [9], [10]. Therefore, our target is to embed the crowdsourcing-based solution into the recycling waste management.

## 3. The Smart Green Management System (SGMS)

The main objective of this system is to facilitate the management of recycling program as part of the green campus initiative. We are also aiming at educating the university community so that they are aware of the importance of recycling program and encourage them to play their role as much as possible in supporting the program. Basically, SGMS offers the following features: 1) recycling education, 2) collecting inputs from the users 3) arranging for collection and transportation of recycling items, and finally 4) generating reports periodically and on demand.

SGMS involves three entities: 1) the green university council, 2) the green city council and 3) the university community. The green university council is a dedicated committee (appointed by the university management) whose responsibility is towards preserving clean and healthy campus environment as well as instilling the right attitude of recycling among the university community. The green city council on the other hand represents the authorities responsible for the wellbeing of the people through safe and healthy environment (MPKJ for instance). The university community consists of all UPM Serdang students and staffs. This group is the key entity of the system which relies upon their inputs and cooperation to work effectively as intended.

The following model namely SGMS model depicts the approach chosen into the design of this system.

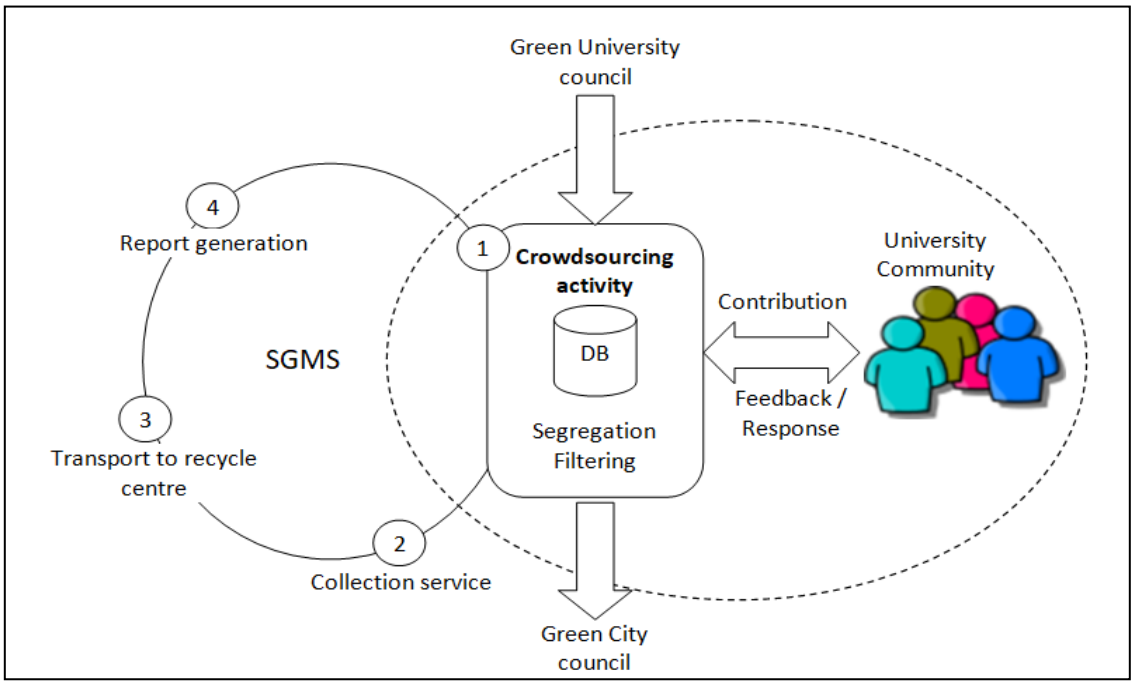


**Figure 1.** SGMS model.

The SGMS is designed to utilize the idea and advantage of crowdsourcing approach. Our premise is that it allows collection of input from large pool of people, fast, immediate action can be taken, cost effective and smarter solutions can be achieved. Adding to these, crowdsourcing also encourage

proactive and caring attitude towards community and surrounding environment. It builds a sense of responsibility and awareness among the community about the importance of smart and healthy living.

SGMS can be accessed anywhere, anytime if the users are connected to the internet by using personal computers, or mobile devices such as tablets or smart phones. This promotes the use of ubiquitous computing services. Moreover, it is easier for the users to submit report using mobile devices in real time and on specific location.

SGMS consists of information concerning recycling campaign including its objectives, activities, benefits, types of recycling items, list of nearby recycle centre, and current market price for the users to view. They can simply take picture of any items of their belongings or waste found somewhere that they think has potential for recycling and submit it with ample description as a report through their mobile devices. They will be informed of their report status by the admin whether it has been received and appropriate action that will follow. This will include the arrangement for collection or meet up.

Basically there are four stages in SGMS. Firstly, based on the input (information), the SGMS will first segregate the input according to the category of information contributed. The categories include report (image with description), complaint, suggestion and general comments. The segregation of information also relies upon the location and time of the item being reported through geo-location data services in the mobile devices. If the input is a report, it will be filtered more distinctively in terms of types of recycling items for example; paper, glass, plastics, aluminum/tin/steel can, or any other indirectly specified items. Next, the system will arrange for collection service according to the availability of the staff in charge. After collection has been made, it will be sent and sold to recycle centre nearby. However, if the input is other than report type, appropriate response will be sent accordingly to the users. The system can generate and produce multiple reports out of the recycling program upon request made by the green university council and green city council.

## 4. Discussion

Nowadays, crowdsourcing has become the hype in knowledge acquisition and diffusion. It is a powerful method that promotes speedy information gathering and at the same time yields better results compared to other similar methods. Increasingly, crowdsourcing has also been actively used for reaching solutions to complex problems. Based on these premises, as well as to demonstrate our social responsibility towards the surrounding community, this paper aims to put fourth our effort through SGMS.

Mobile devices particularly smart phones are in widespread, everyday use and are always connected. Therefore, they offer a great platform for extending existing web-based crowdsourcing applications to a larger contributing crowd, making contribution easier and omnipresent [11]. Crowdsourcing applications on SGMS can be classified as an extension of web-based application. The crowdsourcing approach used in SGMS is known as participatory crowdsourcing where user generates their own data. It is developed in a centralized manner that ship the data generated and collected from the users to a server. In our study, public participation is our primary motivation. We believe in the power and influence of user participation in supporting our effort through SGMS. The notion of using the community for idea generation through implementation rather than relying on the expertise environmentalists ensures a higher degree of community engagement.

## 5. Conclusion

The awareness on the recycling program in Malaysia is required. One way is to start the recycle camping at the university campus. The proposed of the Smart Green Management System is to track the recycling rate and create an online database for recycling management systems. In addition, the SGMS allows utilising resources in efficiency and manageable way. Furthermore, the proposed system can monitor all the transaction and generate a report on the performance of the colleges that active in doing the recycle program.

To achieve a sustainable environment, the waste recycling program needs to be directed to proper end-of-life processes from the recycling process to the disposal process. Respect environmental issues,

changing of lifestyle, and fundamental knowledge of recycling as important aspects potentially sustaining recycling programs. We hope SGMS which reflects its capability to help fast-managing and coordinating recycling will scaling up recycling practices in university campus.

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