Esthetic, integrated, smart and green trash bin for public space: A review

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Abstract. Trash is produced by humans every day from various sources of trash, such as from households, markets, and various industries. Trash consists of various types, forms, and sources. A trash can be a problem because it causes a health problem for human and air pollution. At this time, the awareness of throw the trash to the trash bin still lacks considering especially in public areas. This case is caused by a dirty trash bin, smelly, and neglected. The purpose of this literature review is to find out the theoretical framework to design trash bins in public areas, which managed in an integrated manner so that these problems are not found anymore. The method used in reviewing this paper is by entering keywords trash bin, smart trash IoT, integrated trash bin, and related to trash bin design on google scholar and ScienceDirect, which published in 2015-2019.

1. Introduction
As the population increases, modernization and industrialization in the world result in waste that resulting also increases [1]. So that both developing and developed countries waste management is a challenge in society [2]. According to a World Bank review report [3], in 2012, the level of global urban waste production (MSW) was around 1.3 billion tons per year. This figure is expected to reach 2.2 billion tons per year by 2025. The build-up of waste will result in unhygienic environmental conditions, air pollution, and can cause the spread of several diseases to humans [4]. Waste collection is currently inefficient, time-consuming, and requires a lot of human energy. The usual method for someone to collect rubbish is by going to different places and examining trash bins in each public area. This process is rather complicated and requires quite a long time. With technological advances in recent years, manual waste management methods should have been developed automatically to optimize waste collection [5].

2. Methods
This research is a study using the main approach of literature study or Literature review (LR). Search is done by entering the keywords trash bin, trash bin design, and smart trash bin IoT on google scholar and ScienceDirect, published in 2015-2019. The purpose of this literature review is to find out the terrorist framework in designing aesthetic and smart bins in public areas that can be managed in an integrated manner. The concept of making garbage is done by using two methods, namely the combination table concept method and the Scamper design activity survey, and literature.
3. Result
Table 1 describes the design of the trash in terms of aesthetics by considering the most important functions of the trash bin, such as durability, reliability of the trash bin, while Table 2 describes integrated bins with waste management issues by reducing, reusing, and recycling waste. Table 3 outlines the design of smart bins based on the Internet of Things (IoT) so that they can streamline costs and time in waste management.
### Table 1. Esthetic of trash bin literature review

| Author                  | Title                                                                 | Objectives                                                                 | Methods                                                                 | Results                                                                 |
|-------------------------|------------------------------------------------------------------------|----------------------------------------------------------------------------|-------------------------------------------------------------------------|-------------------------------------------------------------------------|
| Balderas B J et al., 2019 | Improving Garbage Receptacles: Designing an Affective Garbage Receptacle that Influences Human Behavior Towards Littering | To develop an effective trashcan design and raise public awareness to dump | Interviews, surveys, simulation, and observation was made with the help/inspiration Kansei methodology and Shikake | Design is made using Solidworks online software that captures all of the specification requirements. The trash can will cover inside a transparent plastic bag, which will have the same size as the garbage container [7] |
| Nawangpalupi C B and Pambudi N F, 2015 | Design of Trash and Garbage Carts to improve the Garbage Collection System at Forest Forest Parks | Redesigning the place and wheelbarrow through the entire product development process | The concept of making waste is carried out using two methods namely the combination table concept method and the Scamper design activity method | From the results of product development carried out to design trash bins and wheelbarrows, the selected TSMORF1 concept or the concept of plastic bins in the front opening and GSMORF3 or the concept of ironwood trash carts with revised bearings will be developed [8] |
| Nadia S and Herlambang Y, 2019 | Design of Indoor Trash Bin with The Function of Sorting and Compaction at Telkom University | Designing bins that are designed according to the needs of waste bins and cleaning service personal needs | Field observations, questionnaires, and interviews with cleaning service personal | Design products of trash bin [6] |

### Table 2. Integrated of trash bin literature review

| Author                  | Title                                                                 | Objectives                                                                 | Methods                                                                 | Results                                                                 |
|-------------------------|------------------------------------------------------------------------|----------------------------------------------------------------------------|-------------------------------------------------------------------------|-------------------------------------------------------------------------|
| Farizal F et al., 2017  | Indonesia's Municipal Solid Waste 3R and Waste to Energy Programs     | This study aims to determine the optimal proportion of MSW treated through the 3R and WTE program | The 3R concept and the WTE program                                         | The results show that the optimal proportion of MSW through the 3R program is 49.90%, 12.37% through the WTE program. This leaves 37.73% of untreated waste. The electricity generated from the WTE program reached 1,229,695 GWh, the total emissions saved were equivalent to 1,809,208.2 tons of CO2 and the total land use for this program was 4,036,239.1 m2 [9] |
### Sudibyo H et al., 2017

**Title**: Municipal Solid Waste Management in Indonesia - A Study of Selection of Proper Solid Waste Reduction Method in Yogyakarta Province

**Objectives**: Aims to study the best scenario that will be applied in waste management in Yogyakarta.

**Methods**: Using two scenarios to be assessed, namely, Scenario 1: TPST is operated, but without the reduction of waste at the source and Scenario 2: TPST is operated together with the reduction of organic waste at the source.

**Results**: From the results of modelling, Scenario 1 can make the amount of waste entering the landfill site at Piyungan not more than 300 tons/day. Scenario 2 is applied, the amount of waste that enters the Landfill Site Map can be reduced to a maximum of 200 tons/day [10].

### Bing X et al., 2015

**Title**: Research Challenges in Municipal Solid Waste Logistics Management

**Objectives**: Comparing the literature on general logistic modelling of municipal solid waste

**Methods**: Literature review

**Results**: Review planning and managing waste by reducing waste at the location as close as possible to the source of waste with an approach through legal, institutional, operational techniques, financing aspects, and aspects of the active role of the community [11].

| **Author**      | **Title**                                    | **Technology**          | **Methods**                                                                 | **Results**                                                                                                                                                                                                 |
|-----------------|----------------------------------------------|-------------------------|-----------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Khowshalya R and Vani E, 2019 | Collecting Wastes from Trash Can use LoRA | Atmega Microcontrollers and the LoRA | Design of the trash can consist of sensors and GPS device support for location identification. If the trash bin is filled in, it automatically generates messages to the city unit using the LoRa module, and the LoRa module in the city unit receives the message. The information is transferred to a specific garbage collection truck in the area to collect the garbage from the filled trash bin. Equipped with | Not yet implemented a waste separation technique based on the type of garbage |
| Author                  | Title                                                                 | Technology                                                                 | Methods                                                                                                                                   | Results                                                                 |
|------------------------|----------------------------------------------------------------------|----------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------|
| Pawar SS et al., 2018  | Smart Garbage Monitoring System Using AVR Microcontroller            | Atmega 16, IR sensor, wifi module ESP8266, SIM 800, GSM modem, GPS module SKG 13 BL, ThingSpeak | Propose system monitors in the trash based IoT to detect the level of the threshold of garbage on the LCD screen, if it has reached the limit then the SMS message will be sent to people who transport the garbage | Not yet applying the techniques of waste separation the type of trash [12] |
| Mustafa MR and Ku Azir KnF, 2017 | Smart Bin: Internet-of-Things Garbage Monitoring System | ARM microcontroller MBD LPC 1768, IR sensor, wifi module ESP8266, SIM, ThingSpeak website | Propose a monitoring system on an IoT-based trash bin by detecting the level of garbage threshold levels on the screen LCD. When it reaches the limit, the data from the sensor will be sent to ThingSeak. So waste management can be monitored based on the level of waste depth in ThingSpeak. This system monitors the depth of waste by type of waste. | Not to implement waste separation technique based on the type of waste and the system has not been connected directly via phone to direct waste hauler officer [4] |
| Neetha, et al, 2017    | Smart Bin- An "Internet of Things” Clean and safe Approach to Public Space | Arduino, sensors, module wifi, cloud | Proposes an IoT-based rubbish monitoring system by detecting the level of the threshold level of rubbish bins using an ultrasonic system. If you have reached the threshold, the trash can status will be uploaded to the cloud and used to monitor the trash | Has not yet implemented waste separation techniques based on the type of waste and the system has not been connected directly via the garbage collection officer directly [13] |

4. Discussion
Waste is a complex problem in each place. The condition of trash cans that are dirty and need special rot in public areas makes people do not need to throw garbage in the place. This will improve waste collection and inefficient waste management. Will have an impact on the environment that becomes unhealthy, polluted, and will cause disease in the surrounding community. Therefore in this paper, we discuss the design of the trash bin terms of esthetic, integration, and sophistication to increase public awareness to dispose of waste in the place. Table 1 outlines the design esthetic of the trash bin that is
designed by considering the function of the trash like durability, contradiction, and more. Table 2 outlines the problem of managing waste by reducing, reusing, and recycling waste. Table 3 describes the IoT-based garbage design while the IoT-based garbage design can streamline costs and time in waste management.

5. Conclusion
The results of reviews of various existing journals can be concluded that the design of the esthetic trash bin design must consider the most important functions of the trash, such as durability, reliability. The design of the proposed IoT-based trash bin design can streamline the process, time, and cost of waste management, one of which is by applying waste separator techniques based on the type of waste. And integrated with waste management that can reuse and recycle waste to reduce the amount of waste.

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