Smart Bin for Waste Segregation and Energy Generation using IoT

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Abstract— In this paper, we proposed a smart bin that can notify the municipal corporation at multiple stages of waste disposed. Whenever it reaches 30%-60%, it sends an alert to the trash collector appointed to the region. When the percentage reaches 90%, an alert will be sent to the appropriate relevant officials. Even after all those warnings, if the trash is not extracted, it falls into another recycling chamber at the below the bin. The trash is combined with biocullum in this chamber, that disintegrates the biodegradable waste into fertilizers. The treated trash is then sieved through a shaking sieve, and the plastic/glass or non-biodegradable trash is segregated from the fertilizers produced and moved to a different unit. Non-biodegradable trash has been obtained in a separate container. The waste generates biogas while processing is collected and stored for use in the production of power. The gas collected is then burnt to produce heat and is provided to Peltier sensor which in turn generates electricity with the heat supplied to it.

Keywords—IoT; Peltier Sensor; Fertilizers; sensors; level detection;Smart Bin;Electricity Generation;

I. INTRODUCTION

The nation 's development and economies are rising day by day, in parallel with the rapid progress of science and technology. The advent of WSN systems and wireless communication systems has created a lot of possibilities for creators and experts who work on developing Sensor networks for socially important projects. Several people are becoming quite reliant on technology regarding many aspects such as efficiency, ease of use, and privacy as a result of this development. People have begun to adopt new emerging technologies and devices, such as smart phones and intelligent connected home.

IoT gives everyone and everything the ability to be intelligent and interact to the rest of the community via the Web. The Internet of Things has caused world Smart Cities, that refers to everything anything that is hooked up to the network and operated by research and technology.

Smart Waste Management is among the most important digital devices recognized within Smart City. Sanitation and wellness contribute to a prosperous and safer environment,

so proper processing of waste is a serious hurdle in the growth of Smart Cities. The Smart Garbage Bin is a machine designed to solve waste disposal problem. The whole device will use level detectors to identify the actual condition of the container and delivers real notifications to the trash collector This allows the Trash Collector to keep a record of the container and pick up when it is full, preventing container overspill. Aside from that, the bin allows for automatic garbage fertilization in the event that the trash collector fails to collect it. Whenever the bin is full, the lids beneath it unlock, allowing garbage to fall into the second chamber. The second chamber has fertilizer application functionality, which converts trash to compost in a quite short span of time.
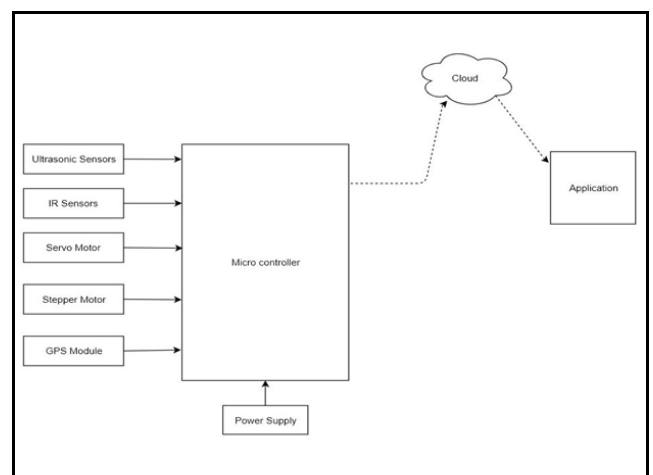

Fig 1: System Architecture

II. LITERATURE SURVEY

A. A cloud based smart recycling bin for in-house waste classification

(Dimitris Ziouzious, Minas Dasygenis, Nikolas Baras, Constantinos Tsanaktsidis)

The coverage provided by this article is a reduced use the cloud's cost-effective recycle bin support to improve with trash filtering and personal internal use. The Centrally controlled Information System (SI) gathers smart bin statistical data that can be mounted from everywhere and remotely. It uses Artificial Intelligence and Neural Networks to categorize the waste for each bin. Their design is characterized by categorizing different forms of waste with an accuracy of 93.4 percent, while the price of implementation and use of electric power is very low compared to other architectures. Individuals had also proposed an advancement of their past researches, a newly developed intelligent dumpster and IoT program that utilizes machine learning (ML), Artificial Intelligence (AI) technologies with Computational Extinguish to the cloud so it can recognize and arrange the waste which is being disposed of (in paperboard, polycarbonate, etc.) and different forms (e.g. Bottles, Buckets).

In order to assist with reuse or recycling, the suggested intelligent containers would be implemented in citizens' residences. As all sequencing is executed on a cloud, intelligent containers could use affordable and less effective gear. This enables our device to be an alternative that is cheap and workable.

Through our Intelligent Dumpster implementation, there have been 2 significant physical systems: The Rasp Pi Zero W and Camera Module for the same. For the three variables, as they noted, the raspberry pi zero board is indeed very appropriate for one's proof of concept because: (a) it has quite negligible prices needed for our proof of concept, (b) it's also quite energy efficient since during standard loads it uses up only about 200 Amp and (C) and has a really small design. When that trash enters the dumpster, the digital camera takes a snapshot of the thrown away item. The Raspberry Pi Zero communicates the collected picture to IS using the Wi-Fi gadget. Just after data center IS has acquired the collected file, the garbage identification process occurs. If the Intelligent dumpster obtains the classification updates from an IS as if the garbage material could not be recognized by a IS, the trash is deposited inside a dumpster of general non-recyclable trash. In order to identify the contentedness percentage, an ultra - sonic device is installed within each container.

B. IoT Based Smart garbage monitoring and collecting system using WeMos and Ultrsonic sensors

(Faisal Karim Shaikh, Abdul Aziz Memon Naeem Ahmed Mahoto, Kulsoom Memon)

The purpose of the initiative is to build a budget friendly Internet of Things infrastructure that, with the use of smart technology like WeMos and Ultrasonic sensors that use limited resources, Waste Management Authorities can monitor everyday waste in real circumstances. The results demonstrate accurate real-time monitoring of waste monitoring in trash bins. The above program takes exceptional services of the method of management, sorting and recycling of waste from trash bins situated at several geographical locations. The dumpster has an ultrsonic sensor and it is wired to the WeMos D1 mini, it's kind of designed Wi-Fi functionality to navigate the data of the Arduino board sensor A HC-SR04 ultra - sonic architecture detector is included in each vessel to confirm the quantities of sludge in the bin. HC-SR04 Ultrasonic Sensor There are driven by four pins. 'There's one pin in use by the VCC (5 volt), one of the pins is being used for the ground, the regulate pin is used for ultrsonic pulse transmitting, and the using eco pin the echo of the transmitted signals. Garbage composition evaluation can be a part of any business, house, shopping Centre or city hall. Garbage can alert collection trucks to collect trash from this particular dustbin according to tracked results. The integration process is reasonably priced as for other options, especially in comparison to Surveillance Cameras and RFID tags for the following purposes media analysis to figure out the state of Trash bin. The research suggested digital reporting and monitoring of waste and with lower cost, more productivity and period, the selection process Save an integrated device detected volume of waste in the trash bin and transmit the data obtained via the internet using Wi-Fi. With the corresponding IP address, connectivity is simple on the application layer. Analysis indicate that the range values obtained were precise in actual environments.

C. An intelligent Garbage Bin Based on NB_IoT Research Mode.

(Junhui Lai, Peng Pan, Guorong Chen, Mou Zhou, Jie Li, Hong Ren)

This is a Narrowband Internet of Things (NB-IoT) technology-based smart trash can, It is distinct from a regular container of waste. It is adding a Detection of waste and identification functions based on the Internet System of interpretation of items, through infrared sensors, , odor It uses NB-IOT sensors to accomplish different tasks. System for interaction to send data. This latest one Smart waste bin will get the maintenance staff to get the Details as to whether the garbage is full or even if the rubbish may or may not be toxic. To determine, whether the garbage is maximum or not the infrared sensor is used, and the details are displayed. The transmitting part is not shown above the garbage bin. Supporting the transmission of LPWA and another new IoT Model. Describing the recent scope of the NB-IoT network, the result is not ideal, but consistent with the current GPRS. The pushing function is split into APP push and Push SMS. Push functionality contains details from the waste container, Geographical region, and so forth, and additional help Role for Reviews. The cloud treats the front-end appliance in a single fashion. Also, it is able to store data, processing data, then push the total garbage bin details into the bin janitors' hands. Use of odor sensors and horns is to guide individuals to identify waste. The odor sensor is used to measure a type of waste, which can direct people to adequately and accurately identify the garbage Recognize the recyclable materials to further use. Singular panel Photovoltaic solar power generation, electric grid, microcomputers Saving energy, safety of the atmosphere, and sound sustainability.

D. SmartBin: Smart Waste Management System.
(F achmin F olianto, Y ong Sheng Low, Wai Leong Yeow)

They present the Smart bin device in this paper, which detects the litter bin's fullness. Their device is designed to collect data and transmit it through a wireless mesh network. The system also employs the service cycle technique to reduce power consumption and maximize operational time. The smart bin framework was put to the test in an open environment. They gathered data and used sense-making methods to encourage litter bin use and litter bin daily sanitation information via the testbed. Litter bin providers and cleaning contractors can make better decisions to increase productivity with this information. The work presented in this paper illustrates how the Smart bin solution empowers cleaning operators to detect cleanliness issues in real-time. As a result, the device will aid in the improvement of overall productivity and cleanliness.

E. Design of smart waste management system.
(Abhishek Ajith, S. Balaji, R. Marimuthu, Balamurugan S, Snehal Ratnakaran)

They've created a low-cost, low-power waste management system that can be used in areas that aren't environmentally sound. As compared to daily collection, this method allows us to collect trash when and when the can is complete or when the trash inside is decomposed. This was created with an Arduino Uno board, which included additional modules such as a GSM module for sending messages. They've developed a framework for cost-effective waste management. Smart waste management technologies like this would go a long way toward making our daily lives healthier and less toxic. It can also help to reduce garbage truck fuel consumption by going to specific areas for collection only when a sufficient number of cans are present in that specific geographic location. Since it requires less funds, this method will become widely available in all countries that aren't interested in investing heavily in their waste management departments.

Name	"IoT Based Intelligent Bin for smart cities"	"Efficient Garbage Disposal Management in Metropolitan"	"Smart Dustbin"	"Smart Garbage Collection system in residential area"	"Waste Bin Monitoring system using Integrated Technologies"	"Smart Bin Implemented for Smart City"
Bin Measurement	Yes	Yes	Yes	Yes	Yes	Yes
Technology Used	Infra-red	Laser, Photo Diode	Ultrasonic	Webcam, Weight Sensor	Ultrasonic	Infrared
Object Detection around bin	No	No	No	No	No	No
Technology Used	No	No	No	No	No	No
Web UI	No	No	Yes	LCD	No	No
Alert Messages	Yes	Yes	Yes	No	Yes	Yes
Technology Used	GSM	AD-Hoc	GSM	GSM	Zigbee GSM	RFID
Scheduling	No	No	No	No	No	No

Table 1: Survey Comparison Table

(Murugaanandam, Ganapathy, & Balaji, 2018)

III. PROPOSED SYSTEM

The primary goal of this proposed design is to effectively monitor and segregate the trash collected in the city. The basic objective is to detect the garbage levels of the bin and to provide this information to the garbage collector. To develop such a system here is its proposed design:

A. General System

This proposed design consists of a standard bin with sensors and microcontrollers attached for sensing, processing, and data transmission from one end to the other. IR sensors are used to detect garbage levels, the GSM module will be used for send message notifications, and the GPRS module is used to safely guide the collector to the bin.

The bin will be able to detect garbage levels by using infrared sensors located at various levels of the bin. An ultrasonic sensor is used to confirm the presence of trash in the container. When trash levels reach a critical level, a notification is received by the appropriate garbage collectors to avoid delays and save the collector's time visiting each bin.

B. Sensors

- IR sensor will be used to detect the garbage levels at different heights in the garbage bin which will be placed at 30-60-90 percentage of the bin's height. This data will be displayed in the Collectors application for easing the garbage collection process.
- GSM module will be used to send the message notification to the collector so that even if he hasn't checked the garbage status, he will be notified about it so that he does not miss any garbage bin which needs to be collected.
- GPRS module will be used to provide the exact location of the bin to the collector so that he can easily reach the bin in the minimum possible time for the garbage collection process and there is no confusion between the nearby bins in the area.

C. Microcontroller

The microcontroller used will be an Arduino Uno which will be the processing unit for the whole system. It will collect data from all the sensors and provide it to the cloud which will be further provided to the mobile application for the user. Also, it will be programmed in such a way that it will consume minimum possible energy and the sensor readings will be taken after a specific interval of time rather than taking it continuously to save the battery and use it for a longer period of time.

D. Android Application

The android application provided will be used to provide notifications as well as to guide the user to the location of the bin. The android application can send message notifications as well as the normal notification to the garbage collector so that even if he misses one, he gets another notification, just in case. Also, he will be provided with monthly data of the garbage bins in his area so that he can keep a track of all the bins. He will be provided with the fastest way to the dispose of garbage containers that have to be collected making it easier and time-efficient work for garbage collectors.

IV. CONCLUSION

Our Survey presents IOT based smart waste management System by imposing Sensors to monitor the status of smart bin and by doing so we gather the information of the garbage. Due to this information, we can control the overflow of the garbage in public areas and the pollution which generally occurs around the bins. This System can segregate and decompose the decomposable waste material which will be useful for the users mainly who belong to the agriculture field. In future prototypes, implementation of an extra module that generates electricity from the waste material by using Thermoelectric Technology.

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