

IMPLEMENTATION OF SOLAR-POWERED OF SENSORS BASED SMART WASTE MONITORING SYSTEM

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Abstract: Dustbins (or Garbage Bins, Trash Cans, whatever you name them) are small containers of plastic or metal used on a temporary basis to store trash (or waste). They are also used for the collection of waste in houses, workplaces, highways, parks, etc. Littering is a major crime in some countries, and public waste bins are also the only way to dispose of small waste. Usually, using different bins for handling wet or dry, recyclable or non-recyclable waste is a common practice. From an ETS perspective, smart waste collection can help municipalities and private waste management companies avoid the need for collection sites, waste disposal facilities and waste treatment plants. As communities increasingly rely on smart city technology to improve, among other things, the quality of life of their residents and the environment, city leaders recognize that smart waste management can also help them achieve sustainability goals such as zero waste and improve services to residents, while improving service to residents. As an example, Development of Some solar-powered bins and recycling bins are already equipped with sensors that analyze data on what is disposed of or recycled and notify collectors when the bin is too full and needs to be picked up. These developed Smart waste management solutions use sensors placed in waste bins to measure levels, notify municipal waste collection services, when the bins are ready to be emptied, and also notify municipal waste collection with a ton has been emptied. Therefore, the solar-powered of sensors based smart waste monitoring system is more and more useful to the current smart cities policies under the smart city project works.

Key words: Garbage Bins, Smart city Technology, Smart waste management, solar-powered of sensors, smart waste monitoring system.

1. Introduction

Dustbins have improved their algorithms to identify a greater variety of waste and significantly increase the amount of plastic that goes into recycling. This allows for a much more efficient and efficient recycling process, and waste recycling companies use this use. Trash bins are set up to use AI to automatically sort and organize your trash. As traditional techniques are replaced by automated intelligent solutions such as sorting AI robots, we can expect a significant reduction in e-waste[1]-[2].

Dustbins can be set up to sort a variety of different types of waste such as plastic, paper, cardboard and paper towels. Waste and recycling companies are using this to their advantage and are enabling a much more efficient and efficient recycling

process than ever before. Dustbins have improved algorithms to identify a greater variety of waste and significantly increase the amount of plastic that goes into recycling[3]-[4].

Waste detection, space junk and sustainability are just some of the many issues that artificial intelligence will help humanity deal with. Machine learning is not an unrealistic or new concept, and its ability to help the cause of environmental sustainability could also lead to innovative and intelligent solutions[4].

Waste management for the use of recycling and composting is one of the most important aspects of intelligent waste management. Artificial intelligence and robotics offer many opportunities to improve this process[5]-[6], and there is enormous potential for them to be used in a wide range of applications, such as waste collection, waste management and recycling. There are many opportunities for artificial intelligence and robots to improve these processes, especially in the area of waste disposal. Various types of municipal waste sorting machines are already used in waste and recycling plants, such as the municipal waste and energy recovery system and the municipal recycling plant.

The recycling plant uses a number of different machines to move waste to its "right" place, such as the municipal waste and energy recovery system and the municipal waste and energy recovery system (MWRS). Recycling already uses several types of waste separation machines within the municipality to separate waste. To get around this project, we have developed a simple smart garbage can that automatically opens the lid of the dustbins when it is recognized by a human hand and demonstrates its ability to perform synchronous experiments. Object recognition is one of NETra's most important areas of research and development in the field of artificial intelligence[7]. We have already used the object avoidance robot, where a robot can change direction when it detects an object, and we have introduced a similar technique in the object avoidance project, where an ultrasonic sensor is mounted on the lid of a bin and when the sensor detects objects with a human hand, an Arduino automatically opens the lids. We have also placed the ultrasonic sensor at the bottom of each container to detect whether the container is full or not. We have also added GPS data to send it to the location of each container, making it easier to always clean the same container. When the containers are filled, they send a message to a managing authority

1.1. Methodology

We plan to build a smart waste management system for our project that includes things such as a smart location system, a smart tracking system, smart physical operations, etc. It goes in depth with our garbage monitoring system with respect to the problem[8]-[9]. We also introduced a system of garbage control that helps us keep track of our levels of waste. The key idea is that real time monitoring of the waste levels helps to reduce the load on when a large number of dustbins are spread over a field as shown in figure 1.

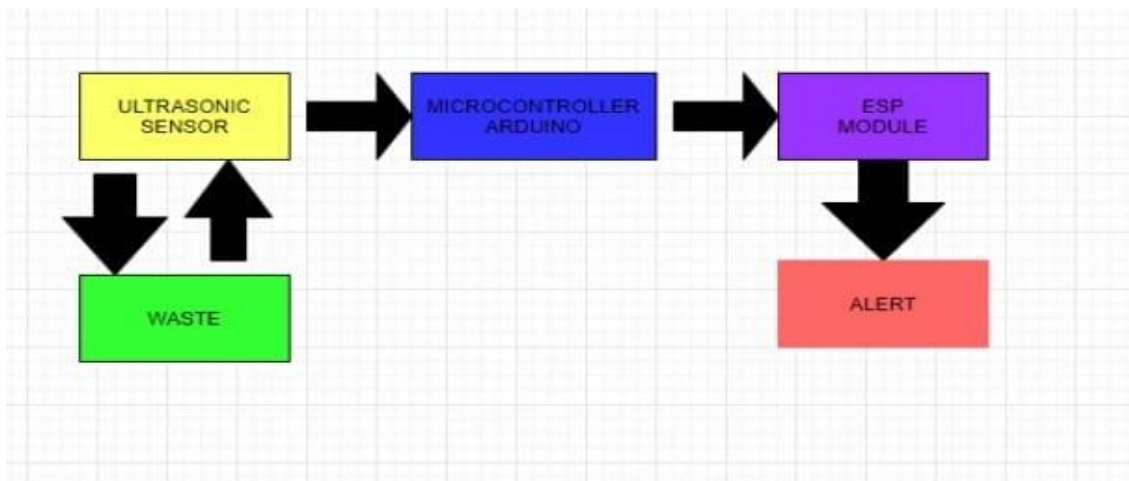


Figure.1: Detailed Level monitoring system where the amount of garbage

We have also implemented a detailed Level monitoring system where the amount of garbage which indicates the levels through a webpage local to the workers / users. Levels are as follow[10]-[11]

Table1: Webpage, when the user requests a query to know the level of garbage

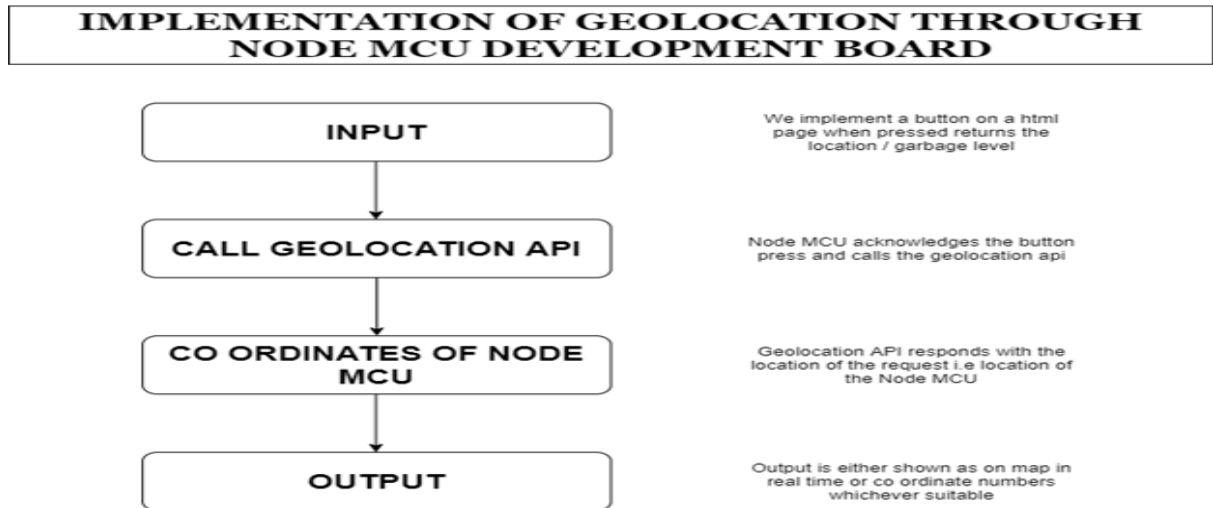
LEVEL	PERCENT	MESSAGE
1	10%	ALMOST EMPTY
2	30%	NEARLY HALF
3	50%	HALF FULL
4	75%	NEARLY FULL

The above table refers as table1 to the messages shown in the webpage when the user requests a query to know the level of garbage. Further add - on like garbage level can be shown on the Google map in real time as well are being worked on .we have thought about a lot of ways through which we can locate our smart dustbin . Some optimal solutions were

- GSM Module with location accuracy - 10m
- GPS Module with location accuracy - 5m
- Geolocation API with accuracy - 2m

Taking into account the scalability of our project we chose geo location considering the accuracy factor and various other advantages that WiFi Based ESP8266 puts on the table like Web controlled buttons , Google map based dustbin location ... etc.

1.2 The flow chart is as follows:



The reason for choosing geolocation based is that when we put many dustbins , gsm / gps won't be as accurate as needed and also the power consumption is higher without any other benefits . So instead we chose this as it can provide benefits like real time monitoring through the web , map based location / level description etc[12]-[13].

To implement this we can either use a standalone api like the one at unwiredlabs.com or google’s own geolocation API found in its Google Cloud Platform (GCP).Practical and reasons why this idea could be a challenge is the specific areas: Proof of Concept as shown in figure 2[14].

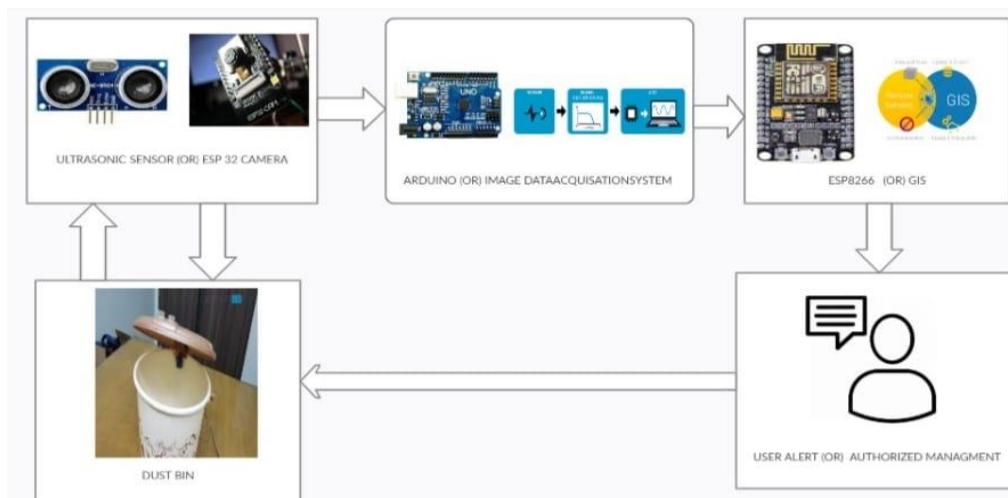
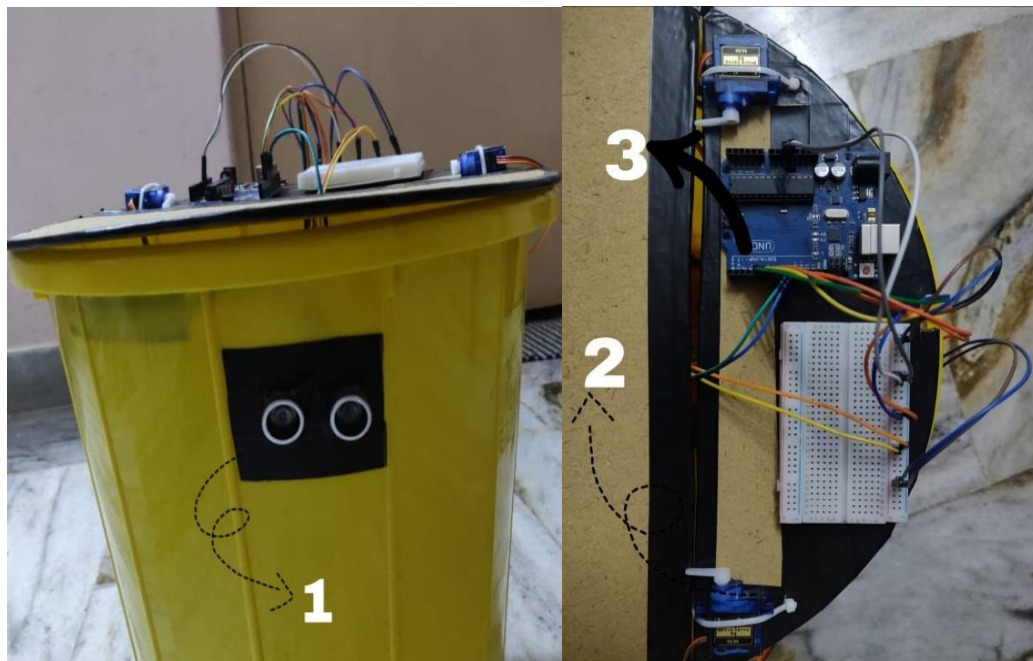
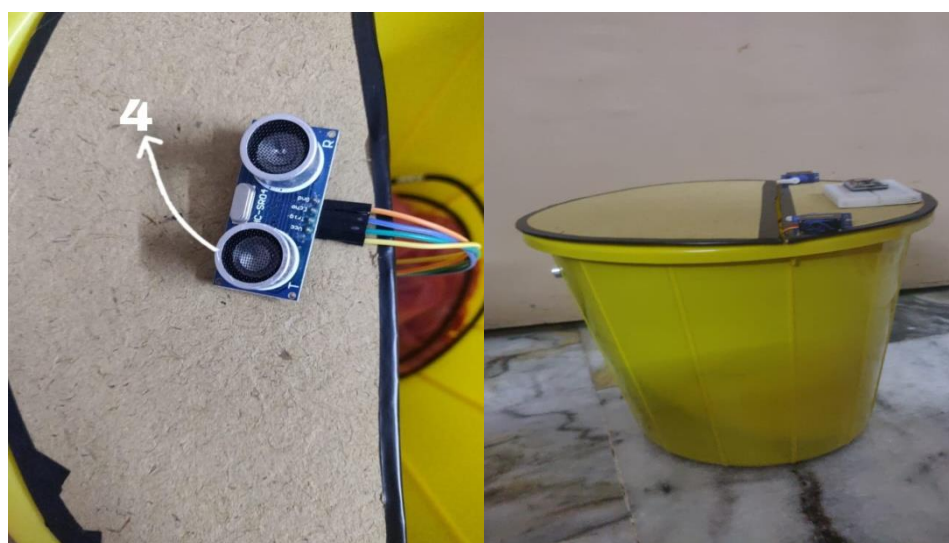


Figure 2: Development of board level with the ESP-12E module



(a)



(b)

Figure 3 (a&b): Implementation of the project proposals

Ultrasonic sensor 1 which is used to open the lid of the dust bin whenever it detects the motion it will instruction to servo motors based on shown the figure 3.

- 1) Servo motors ; when they recive signal from ultrasonic sensor 1 these servo motor helps to open the lid of the bin.

- 2) Arduino uno , a microcontroller device which use to interface the operations.
- 3) Ultrasonic sensor 2 ; this will present under the lid of dustbin wich we use to monitor the level of the waste in the bin.

Node mcu:-

The NodeMCU ESP8266 development board comes with the ESP-12E module containing ESP8266 chip having Tensilica Xtensa 32-bit LX106 RISC microprocessor. This microprocessor supports RTOS and operates at 80MHz to 160 MHz adjustable clock frequency. NodeMCU has 128 KB RAM and 4MB of Flash memory to store data and programs. Its high processing power with in-built Wi-Fi / Bluetooth and Deep Sleep Operating features make it ideal for IoT projects.

- Operating Voltage: 3.3V
- Input Voltage: 7-12V
- Digital I/O Pins (DIO): 16
- Analog Input Pins (ADC):1
- Cost 250 INR
- Manufactured by Espressif Systems

Ultrasonic sensor:-

An ultrasonic sensor is an electronic device that measures the distance of a target object by emitting ultrasonic sound waves, and converts the reflected sound into an electrical signal. Ultrasonic waves travel faster than the speed of audible sound (i.e. the sound that humans can hear). Ultrasonic sensors have two main components: the transmitter (which emits the sound using piezoelectric crystals) and the receiver (which encounters the sound after it has travelled to and from the target)[16].

In order to calculate the distance between the sensor and the object, the sensor measures the time it takes between the emission of the sound by the transmitter to its contact with the receiver. The formula for this calculation is $D = \frac{1}{2} T \times C$ (where D is the distance, T is the time, and C is the speed of sound ~ 343 meters/second).

1.3 Experimental Results and Analysis

Say we implemented the project on a large scale through the help of the government and that the people liked the idea and implemented / installed them in their homes. A typical map is given below with commercial spaces / apartments where people live as shown in figure 4.



Figure 4: A typical map is commercial spaces / apartments of people live

Scenario -1 : If we would have implemented the system through gps , the map would have looked like this where the inner dark circle would be the exact position and the lighter circle would be the range as shown in a map as shown in figure 5 .



Figure 5: Implemented the system through GPS in the map looked for inner dark circle

Scenario - 2 : If the same was implemented through the use of geolocation and WiFi , it would have looked like this . This would make it much easier to locate the dustbin and proceed with further actions as shown in figure 6.

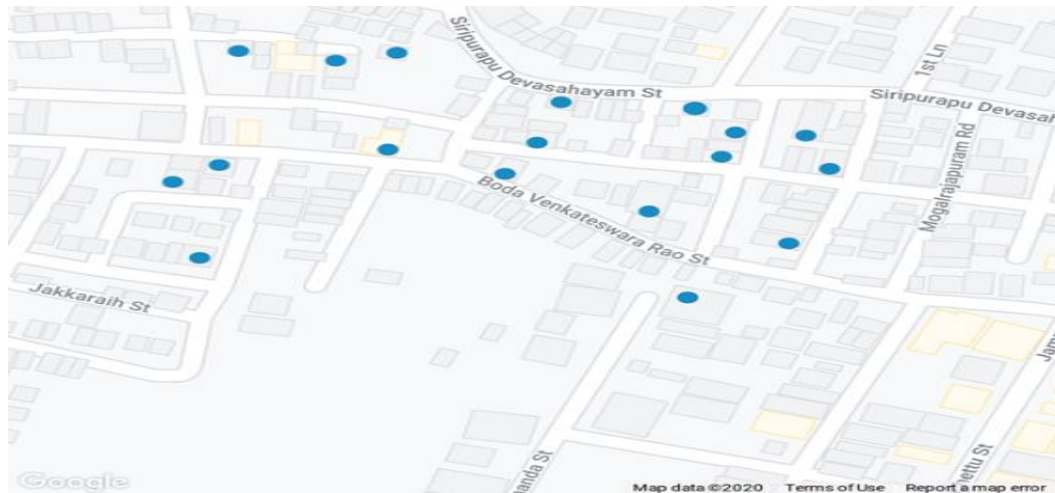


Figure 6: Smart dustbin system which gives the indication of waste levels based on geo tracking of dustbin

As this is a smart dustbin system which gives the indication of waste levels and geo tracking of dustbin. When we see in the perspective of large places such as parks, colleges etc..... They contain more dust bins in these places. If we take a college dustbins are located at various places we control all of them at one place as this system is designed to function like that. It gives the alert to maintenance office of these bins and it will send the location of the bin as shown in figure 6. simply we will receive the location of the bin which was filled as the instance of scaling the level we categorized them into three different levels like (upto 20 to 25%) no issue with it and the second level (25 to 80%) it is the moderate level and the third level (above 80%). when it is up to this level it will give the alert to maintenance department. as a reply to it we can clear the waste in the dust bin.

Conclusion

The method should be used by persons who are able to go a step forward to improve cleanliness in their esteemed regions as a benchmark. In this device, ultrasonic sensors are used to monitor the amount of waste in the dustbins, but with the ultrasonic sensor, several other types of sensors may be used in the future to achieve more reliable performance and move this system to another level. This method can now be used in some areas as shown in figure 4, but can be used in all the major areas as soon as it shows its integrity. As this method also eliminates physical labor as shown in figure 5, some improvements in the system may be made to move it to another level to make it more efficient for the workers and individuals who use it. In the future, it will be possible to build a team to manage and operate this device and even to take care of its upkeep as shown in figure 5.

The primary aim is to preserve the standard of cleanliness in the city and create an atmosphere. This is to live healthier. We will continuously verify the level of the device

by using this system. Dustbins that are located in different areas of the city contain litter. If it has a particular dustbin then the workers can be told and they can automatically achieve the full level. In order to empty it as soon as possible, take those actions. The workers will verify the condition of these bins is on their cell phones at all times. If used, this can prove to be a very useful device as shown in figure 6

References

Journal articles

1. Prof B S Malapur ,Vani R . Pattanshetti(Pg) , “IoT based Waste Management: An Application to SmartCity” , IEEE 2017.
2. Davide Anghinolfi , Massimo Paolucci , Michela Robba, “Optimal Planning of Door-to-Door Multiple Materials Separated Waste Collection”, IEEE 2016.
3. Jayshree Ghorpade , Anagha Wadkar , Janhavi Kamble ,Vijajendrapagare,“Smart Dustbin : An Efficient Garbage Management Approach for a Healthy Society”, IEEE 2018.
4. E. C. Rada, M. Ragazzi, and P. Fedrizzi, “Web-GIS oriented systems viability for municipal solid waste selective collection optimization in developed and transient economies,” *Waste Manage.*, vol. 33, pp. 785– 792, Apr. 2013.
5. H.-Y. Lin and G.-H. Chen, “Regional optimization model for locating supplemental recycling depots,” *Waste Manage.*, vol. 29, pp. 1473– 1479, May 2009.
6. TheodorosAnagnostopoulos, ArkadyZaslavsky, KostasKolomvatsos, Alexey Medvedev, Pouria Amirian, Jeremy Morley, Stathes Hadjieftymiades “Challenges and opportunities of waste management in IoT-enabled smart cities:A survey” *IEEE Transactions on Sustainable Computing* Volume: 2 , Issue: 3, April-2017.
7. Fachmin F olianto, Yong Sheng Low, Wai Leong Yeow, “Smartbin: Smart waste management system” 2015 IEEE Tenth International Conference on Intelligent Sensors, Sensor Networks and Information Processing (ISSNIP) Demo and Video Singapore, 7-9 April 2015.