

Smart Garbage Segregation System Using IoT

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Abstract --In last 5 years Indian Prime Minister has put a lot effort on ‘Smart City’ and ‘Swacch Bharat Mission’ as per his vision India should be considered as a clean nation in world by 2nd October 2022 which is 150th birth anniversary of Father of Nation. A lot of work has done for public awareness to clean their surroundings and put the garbage into dustbins.

We have also seen a problem that wet and dry garbage is thrown in same dustbin which is little bit harder to separate afterwards. So, we have tried to overcome this problem by using a well-known concept in Computer Science called IOT. In this System we will use a microcontroller based on Arduino platform which will control all the sensors. In this system we are using Ultrasonic Sensor, Humidity Sensor, GSM module, Servo Motor. The Humidity Sensor will measure the respective humidity in the garbage if it is greater than specific value than the Arduino board will be programmed in such a way that it will trigger the motor which is fitted in wet portion of dustbin, it will open the door of wet portion otherwise the dry portion of dustbin will be opened. The ultrasonic sensor will measure that how much garbage is in the dustbin. If the dustbin will be filled more than threshold value then Arduino board will trigger GSM module to send message that specific part is filled (wet or dry). Using this system we will be able to overcome the problem of separation of dry and wet garbage.

Keywords –Smart City, Smart Dustbin, Internet of Things (IoT), GSM Module, Humidity Sensor, dry and wet garbage.

I. INTRODUCTION

In the era of growing world, there are many problems that human beings has to deal with and one of them is garbage[1], specifically with garbage separation and management. Because garbage is produced with tremendous pace and as per surveys it will be a big concern in near future [4]:

Table 1: Waste generation per capita in nearer future

Year	Population (millions)	Per Capita	Total waste generation kilo tons/yr
2001	197.3	0.439	31.63
2011	260.1	0.498	47.30
2021	342.8	0.569	71.15
2031	451.8	0.649	107.01
2036	518.6	0.693	131.24
2041	595.4	0.741	160.96

To make 100 smart cities in India is one of the dreams of our Indian Prime Minister. It will be abig concern tomanage garbage in Smart Cities in a smarter way. In today’s scenario we see dustbins full of garbage, and waste fallen around the dustbin, having foul smells and mosquitos around it [2, 3]. Further, it also leads to the health issues also.

Today, there is no effective way to separate dry and wet garbage. Government has taken initiatives like keeping separate bins for dry and wet/green garbage, blue bin for dry garbage and green bin for wet/green garbage. But due to lack of awareness and education people do not throw it in specific dustbin and even literate people, due to carelessness, throw the waste in the same bin. Stats from the survey in Bangalore City about waste management show us the fact related to the same.

Table 2: Knowledge about solid waste in all age groups

Question	For Sample size 200 in Percentage
People aware about wet and dry waste separation in percentage.	90.5
People who are segregating in percentage	74

So, there is an urgent need of a system or technology which can automatically separate both types of garbage.

This problem can be resolved by using IOT. So, we have proposed a system based on IOT, which can solve the problem of garbage separation and monitoring of garbage level in the dustbin, to avoid its overflow. Our system will separate the wet and dry garbage automatically, so there will not be any concern about separating wet and dry garbage manually. Moreover if the dustbin gets full then our system will send a message to concerned authority to empty it. As a result, there won’t be spitting of garbage on road and around the bin.

II. LITERATURE REVIEW:

Though large number of researches has been done on waste management and many such papers are published but in most of the papers, lots of work has been done on measuring the

level of garbage in the dustbin and sending real time level of garbage to the concerned person, many authors have also proposed a system to send the air quality in the dustbin. But yet all the proposed systems lack one of the most important parts of waste management i.e. separating dry and wet garbage.

In [5] the authors has used ultrasonic sensor to measure the level of garbage inside the dustbin, they have also used MQ-4 gas level sensor which measures the quantity of methane inside the dustbin. Methane is one of the gases which is produced during decomposition of waste. But methane is not only the gas present in the waste and it also lacks the solution to improve the quality of air in dustbin. Moreover, MQ-4 sensor is very sensitive towards methane, so even the small amount of methane present in the air can trigger the sensor for a short duration, and hence false information might be sent to the authorities. Further, Wi-Fi connectivity module is used for sending the data to the server, but by using Wi-Fi module the usage of dustbin gets limited to the area where Wi-Fi is available and also cost of dustbin will increase.

In [6] the authors uses GSM module, force sensor, GPS sensor for sending live location of dustbin to the server. Force sensor is used to measure the weight of the garbage inside the dustbin and sends the message to the authorities when dustbin is full, if weight of garbage is more than threshold value. But this system fails if the weight reaches the threshold value but the dustbin is not full. In such case false message will be sent to the concern authority.

In [7, 8] the author has used Level sensor (ultrasonic sensor), toxicity sensor which sends the collected data of dustbin at interval of 15 minutes, they have designed an Algorithm which monitors the dustbins and if any dustbin is full then a truck driver is assigned to empty it automatically by checking the capacity of the truck and also checking the level of garbage in the truck. The system also regularly checks the capacity of truck so that the truck does not get overflowed, and the truck which is empty is sent to empty the bins. In this system they have assigned a RFID card to every user and every user gets reward points for throwing waste into dustbin and they can use this point for their benefits [9]. Typically above system is made very complicated by the author. It is impractical to check which truck is full or empty, if the truck driver cans himself check it and would not put anymore waste into it. And biggest drawback of this system is that the bin will only open if the RFID card is scanned by the user means if any person is not having RFID card or is not registered with the system then he/she cannot throw garbage into the dustbin. So, this system is quite impractical [10].

III. PROPOSED SYSTEM:

Our proposed system will solve the following current scenario:

1. Separation of wet and dry garbage.

2. Notifies the concern authority, when dustbin is full, to avoid spitting of garbage on roads.

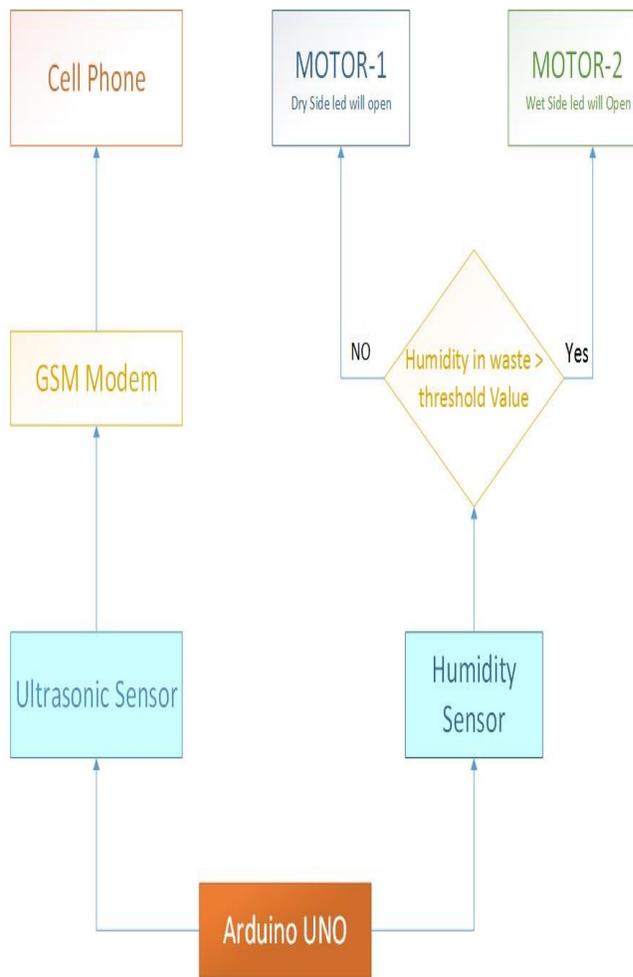


Fig. 1: flowchart of System

Our System has mainly two modules:

One, which measures the humidity in the waste, by humidity sensor, and separates the waste accordingly, by triggering the specific motor of the lid of Wet or dry portion of dustbin and opening that lid for allowing the garbage to slip in. Arduino Board will be programmed in such a manner that if the humidity measured will be greater than threshold value then it triggers the motor of wet part, otherwise it will trigger the motor of dry part of the dustbin [11].

Second, which checks if the dustbin is full or not. Here, the ultrasonic sensor throws the sound waves, and according to the waves received, program will decide if the dustbin is full or not. If, the dustbin is full then the GSM module will send a SMS/ message to the concern authority that the dustbin is full now, and it's time to empty it. SMS also contain the information of which part of dustbin is full and the location

of the dustbin for the ease of tracking it by the waste pick-up truck.

Design and Detailed Explanation

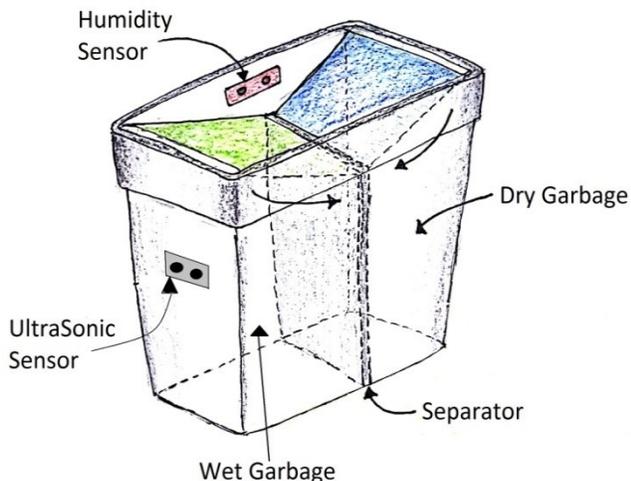


Fig 2: Design Of System

1. Separation of garbage :

As shown in the design above, the Smart dustbin contains two separations: one for the dry waste and other for the wet waste. Just above the gates/lids there is a humidity sensor, when the garbage is thrown on the top, between wet and dry lid, sensor will measure the amount of humidity in the garbage.

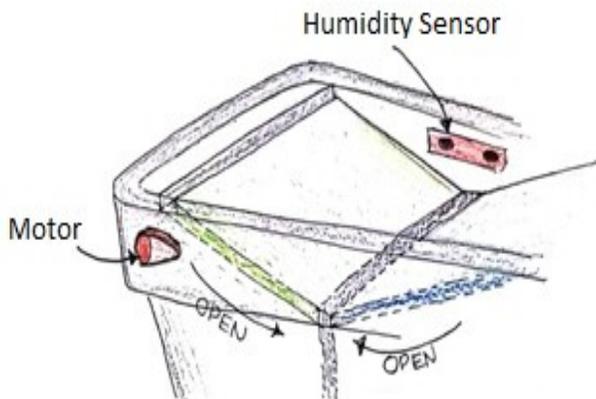


Fig 3: Design of humidity sensor and motor

If the value of humidity measured is greater than certain threshold value then the Arduino will send signal to the motor of wet side, fitted at the hinge of the lid, to rotate by 60 degree downwards and open the lid, to allow the garbage to slip in. And if the value of humidity is less than certain threshold value then the Arduino will send signal to themotor of dry side and similarly allows the garbage to slip in.

2. Check Fullness of Dustbin :

The ultrasonic sensor is fitted at the side wall of the smart dustbin. Ultrasonic sensor has two pins: Trigger and Echo, Trigger sends the sound wave towards the wall of the dustbin and Echo receives the reflected waves. Time taken by the wave to travel and reflect back is recorded and speed of the sound wave is known, so we can easily calculate the distance by the formula [2, 8,12]:

$$\text{Distance} = (\text{speed} * \text{time}) / 2;$$

Here,

Distance = distance of sensor from any obstacle in between (garbage).

Speed = speed of sound wave from the ultrasonic sensor.

Time = time taken by the wave to travel and reflect back to the sensor.

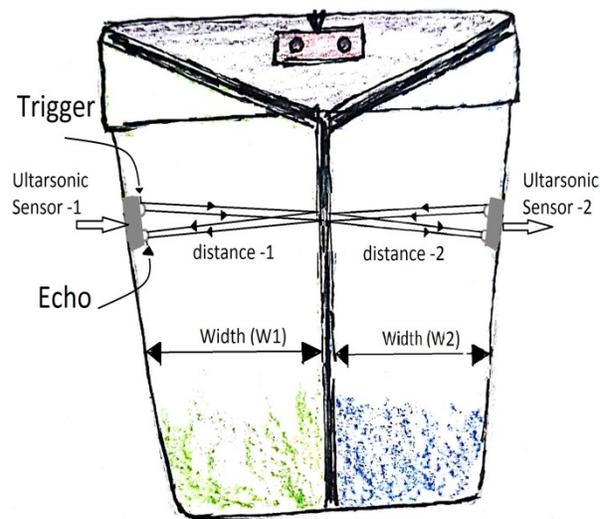


Fig 4: Working Of UltraSonic Sensor

Now, initially when bin is empty, the ultrasonic sensor gets the distance equals to the width of the respective part of the bin (either wet or dry part). And gradually when the dustbin starts filling and at some point when the garbage blocks the way of ultrasonic sensor and the wall, the distance measured

will not be equal to the width of the bin. Now, when such situation arises the ultrasonic sensor checks the distance at respective intervals to make sure that dustbin is actually full and it is not getting the false distance due to opening and closing of lid.

Once, it makes sure that garbage is only blocking the way of ultrasonic sensor and the side wall. So, it is confirm that bin is actually full. Now, the GSM module is activated, the GSM module is used to establish wireless communication between computer and GSM-GPRS, it contains a SIM which supports the connectivity. Here in our system when the GSM module is activated it sends a desired message to the concerned authority to empty the bin, also message can contain the location of the bin of the ease of tracking it.

Further, the Aurdino also sense from which ultrasonic sensor (either of wet part or dry part) the fullness signal is arriving (or sense in which sensor distance is not equal to width) and further that information is also included in the message, whether dry part or wet part is full.

Finally, both this module is controlled by Arduino UNO. Arduino UNO gets the information from humidity sensor and decides which motor to operate. And also it gets information from ultrasonic sensor at regular interval, and decides whether dustbin is full or not, and if it is detected full then Arduino activates the GSM module to send the SMS.

IV. CONCLUSION

In this research paper we have proposed a system which can resolve present problems of separating dry and wet garbage manually. Moreover by implementing this system our nation may save a big amount of money which is used for processing the garbage after collecting it because by implementing this system we will able to collect already separated garbage. It also solves the problem of garbage spitting on road due to overflowed dustbins.

V. REFERENCES

- [1] Alexander, M., &Walkenbach, J. (2013). *Excel dashboards and reports*. Hoboken, NJ: Wiley.
- [2] Narayan, S., Nirman, S., &Tanmoy, D. (2015). Smart Bin Implementation for Smart Cities. *International Journal of Scientific & Engineering Research*, 6(9), 787-789.
- [3] Prahsan, P., Punith, G., Hema, R., &Arti, A. (2016). Waste Management Survey OF Bangalore City. *International Journal of Management and Applied Science*, 2(12), 137-141.
- [4] Annepu, R. (2012). Sustainable Solid Waste Management in India. [ebook] Available at: http://www.seas.columbia.edu/earth/wtert/newwtert/Research/sofos/Sustainable_SWM_India_Final.pdf [Accessed 26 Aug. 2018].
- [5] Dugdhe, S., Shelar, P., Jire, S., &Apte, A. (2016). Efficient waste collection system. *2016 International Conference on Internet of Things and Applications (IOTA)*. doi:10.1109/iota.2016.7562711.
- [6] Kumar, S. V., Kumaran, T. S., Kumar, A. K., &Mathapati, M. (2017). Smart garbage monitoring and clearance system using internet of things. *2017 IEEE International Conference on Smart Technologies and Management for Computing, Communication, Controls, Energy and Materials (ICSTM)*. doi:10.1109/icstm.2017.8089148.
- [7] Mirchandani, S., Wadhwa, S., Wadhwa, P., & Joseph, R. (2017). IoT enabled dustbins. *2017 International Conference on Big Data, IoT and Data Science (BIGDATA)*. doi:10.1109/bigdata.2017.8336576.
- [8] Distance Measurement using Arduino Ultrasonic Sensor: Code & Circuit Diagram. (n.d.). Retrieved from <https://circuitdigest.com/microcontroller-projects/arduino-ultrasonic-sensor-based-distance-measurement>.
- [9] Grove - Temperature & Humidity Sensor (SHT31). (n.d.). Retrieved from <https://store.arduino.cc/usa/grove-temperature-humidity-sensor-sht31>.
- [10] Feetech Mini Servo motor 120 degrees 9g. (n.d.). Retrieved from <https://store.arduino.cc/usa/feetech-mini-servo-120-degrees-9g>.
- [11] Badamasi, Y. A. (2014). The working principle of an Arduino. 2014 11th International Conference on Electronics, Computer and Computation (ICECCO). doi:10.1109/icecco.2014.6997578.
- [12] Yoannan, S. N. (2013). Security System Based on Ultrasonic Sensor Technology. *IOSR Journal of Electronics and Communication Engineering*, 7(6), 27-30. doi:10.9790/2834-0762730