

DESIGNING OF IOT BASED SEPARATION OF GARBAGE

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ABSTRACT

Waste management is currently one of the most pressing issues in both urban and rural regions. In both types of locations, things are getting worse by the day. However, the situation is rapidly deteriorating in major cities. As a result of the lack of adequate waste management in large cities, there may be an increase in health awareness, as well as a negative impact on our environment. Pollution can also hasten the spread of numerous diseases in the environment, leading to epidemics. It not only has an impact on humans, but it also creates a hazardous environment for animals. Waste management is a long-term development problem for both developed and developing countries. In this contemporary day, we must develop and implement a new type of technology capable of handling enormous volumes of waste in densely populated metropolitan regions. We looked at a number of recent research articles on smart waste management systems, and we found that almost all of them had significant faults as well as improvements. We've built a smart IoT-based integrated system with an identifying system as a consequence of our experiences with these types of circumstances. To programmer, the Arduino Uno is utilized. Using an ultrasonic sensor, the amount of trash is detected and quantified. When the garbage can is full, a buzzer ring. The LCD, on the other hand, is utilized to display the garbage level. The GSM module transmits a particular message to the authorities when the garbage is full, alerting them. A servo motor is the mechanism that flips the lid open. The primary objective of such a project is to reduce Laboure requirements, prevent waste overflow, save time, be more cost efficient, and, most importantly, be a fully automated system.

Keywords: - IoT, Smart Garbage Management System, Arduino uno, Urbanization, GSM Module.

INTRODUCTION

As we all know, a massive amount of garbage is generated every year all around the world. So, in order to manage such a large amount of garbage, we must develop a good management system to handle all of the ingredients, which must begin with the most basic technique, which is smart trash. The separation of moist and dry garbage is known as waste segregation. Waste is unavoidable, and the components that it contains have an impact on human and environmental health. Of course, trash management is important, and one approach is to properly separate wet and dry garbage so that dry waste may be recycled and wet waste can be composted. When garbage management is done effectively, it not only removes waste from the environment, but it also decreases the amount of

greenhouse gases emitted by collected waste, such as methane and carbon monoxide. The depth of current landfills will also be reduced, reducing the amount of hazardous waste in the environment. As a result, the environment becomes cleaner and greener.

As a result of increased urbanization, the country is facing a severe waste management problem. Every year, over 377 million people live in 7,935 localities, generating 62 million tons of municipal solid waste. Only 43 million tons of garbage are collected, 11.9 million tones are processed, and 31 million tons are buried. Solid Waste Management (SWM) is a critical service provided by local governments around the country in order to keep cities clean. Almost all municipal authorities, on the other hand, carelessly dispose solid trash to a dump yard inside or outside the city. According to experts, India's garbage disposal and management system is faulty. [1]

Increased trash production is a result of population expansion, urbanisation, and industry-alization all over the world. By 2050, cities will be home to more than 64 percent of the people in developing countries and more than 84 percent of the population in developed countries. As a result, waste management has become a global issue with a wide range of environmental and social implications. [2]

Annually, the world produces 2.01 billion tonnes of municipal solid waste, with at least 33% not being handled in an environmentally sound manner. Global garbage production is expected to increase to 3.40 billion tonnes by 2050. The average quantity of garbage produced per person each day is 0.74 kilogrammes, although this varies greatly, ranging from 0.11 to 4.54 kilogrammes. The overall amount of garbage produced in low-income countries is expected to have more than tripled by 2050. [3].

In India, rag pickers play a crucial role in the recycling of urban solid waste. Because of skin disorders, respiratory infections, gastrointestinal infections, and multisystem allergic illnesses, as well as a high incidence of mouse, dog, and other vermin assaults, rag pickers and conservancy workers have a higher morbidity rate. Segregation at the point where municipal waste is generated can help to decrease the need of rag-pickers. [4]



Fig. 1 Indian trash

In the above-mentioned Fig.1, we can see that there has been an excessive amount of trash in India in recent years, and that nearly every human being is to blame. Some poor employees are continuously cleaning it, but they are unable to make the necessary changes since it is much larger than we believe.

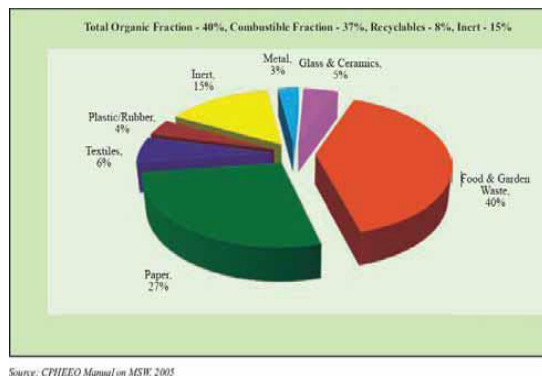


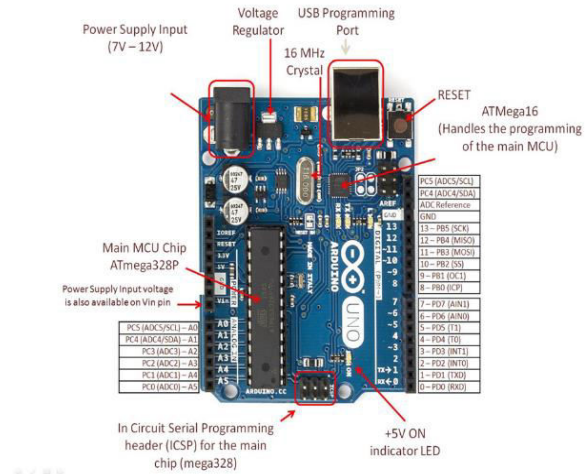
Fig. 2, Composition of MSW in a Typical Indian City (MSW = Municipal Solid Waste)

As indicated in Fig. 2, in Indian cities, 40 percent of solid waste is food and garden trash, 5 percent is glass and ceramics, 3 percent is metal, 15% is inert, 4 percent is plastic/rubber, 6 percent is textiles, and 27 percent is paper.

INTRODUCTION OF ARDUINO

Arduino is an open-source hardware and software business, project, and user community that creates single-board microcontrollers and microcontroller kits for making digital gadgets and interactive objects that can detect and function both physically and digitally (see fig. 3). The GNU Lesser General Public License (LGPL) or the GNU General Public License (GPL) are used to license its products, making it possible for anybody to build Arduino boards and share software. Arduino boards are either preassembled or marketed as DIY kits. [5] Arduino boards employ a variety of microprocessors and controllers. Digital and analogue input/output (I/O) pins on the boards can be linked to expansion boards, breadboards (shields), and other circuits. Some versions feature serial communications connections, as well as USB ports for loading

software from personal computers.



garbage is placed into the bin, an ultrasonic sensor dynamically detects the distance of waste packed inside the bin. If the bin is filled to the threshold distance, the red LED will illuminate, signaling that the bin is full. With the aid of IoT, all of the filled bins will be detected. It means the garbage has been emptied and should be cleaned.

4. Akshay Mahendrakar, et.al, 2020 [9] – Proposed as for the lid-opening situation and the separation of dry and moist trash, a smart waste bin has been effectively deployed. To avoid any human touch or interference, motion detection is utilized. The bin's functionality is tested for various sorts of garbage, with positive results. Because the bin only has two sections, the system considers metallic things to be dry and places them in the dry compartment. The suggested device can identify both metal and plastic trash. The dustbin is opened by hand waves, which the ultrasonic sensor detects and opens the lid of the dustbin. Waste can now be dropped on the platform of a waste separation compartment, which has a moisture sensor on it, and after sensing the waste type, it is dropped into the desired compartment of a dustbin.
5. Preeti Dhiman, et.al, 2021 [10] – Presented as with the massive growth in global population, the quantity of garbage created by each person on a daily basis has skyrocketed. Some trash can be recycled, while others cannot. It has become necessary to create a system that automatically separates distinct sorts of garbage for this purpose. We suggested a Smart Garbage system as a solution to this problem, which not only segregates the metallic, dry, and wet trash, but also converts the wet waste into compost automatically. The wet waste is converted into compost so that it may be utilized in horticulture, urban agriculture, and organic farming. Along with these two functions, it also sends an IoT warning to the waste management center if any of the metallic or dry garbage bins is full, preventing overflowing landfills and major environmental risks. As a result, we have suggested this work to preserve hygiene and cleanliness in public spaces in order to correct all of the anomalies.
6. Aiswarya Kannan, 2021 [11] – Demonstrated as when the waste bins are continually full, there are several noticeable negative consequences. One of the most noticeable consequences is that the surrounding environment begins to smell and become quite unpleasant. People throw their rubbish on the edges of garbage containers when they are full. When this is done for a long period, it begins to stink. As a result, those who arrive later prefer to avoid getting too near and instead put their waste into the garbage cans. If there is any food left over, throwing it causes it to spill.

Cats, dogs, and flies are attracted to this. Another detrimental impact is the spread of infections. It is not only rubbish that spreads them; animals can also be a source.

Methodology

In Simple terms, the separation of moist and dry garbage is known as waste segregation. Garbage production is inescapable, and the waste's contents have an impact on human and environmental health. Trash management, of course, is necessary, and one way to do it is to separate wet and dry trash, allowing dry waste to be recycled and wet waste to be compacted. In this automatic segregation using Arduino and GSM, focus on the Arduino programming idea. The trashcan can tell the difference between wet and dry garbage thanks to its programming. Arduino functions as a brain, allowing us to upload programming and permit our trashcan to use IR sensors, servo meters, moisture sensors, ultrasonic sensors, buzzers, and LCDs. As I previously stated, the sensor is configured such that when a user places or throws rubbish in it, the Arduino sends a signal to the IR sensor and moisture sensor. The waste is detected by the IR sensor first, and then the signal is sent to the moisture sensor, which assists in determining whether the rubbish is wet or dry, and finally the signal is sent to the radio for further decision-making. And based on that selection, the rubbish can be flipped to the wet side or vice versa. However, Arduino may perform a variety of other functions, such as sending a message through GSM module when the trash reaches its maximum capacity. Buzzers may also be controlled by an Arduino programmer, which acts as an alert for the user at the moment. This trashcan LCD acts as a pair of eyes, displaying the dustbin's level. The circuit for this trashcan is quite sophisticated, but you may easily utilize it for future generations because it functions similarly to AI or automated machines.

COMPONENT

- Arduino Uno
- GSM Module
- LED (2)
- LCD
- Ultrasonic Sensor
- Moisture Sensor
- Buzzer
- Servo Motor
- Battery

DESCRIPTION

Arduino Uno

The ATmega328P microcontroller is used in the Arduino Uno microcontroller board (datasheet). Six analogue inputs, a 16 MHz ceramic resonator (CSTCE16M0V53-R0), a USB port, a power connection, an ICSP header, and a reset button are among the features. It includes everything you'll need to get started with the microcontroller; all you have to do is connect it to a computer through USB or power it using an AC-to-DC converter or a battery. [12]

GSM Module

A GSM Module (as shown in Fig.4) is simply a GSM Modem (such as SIM 900) connected to a PCB with various types of outputs removed from the board (such as TTL Output) (for Arduino, 8051 and other microcontrollers). Pins or facilities for attaching a microphone and speaker, as well as detaching +5V or other power and ground connections, will be included on the board. [13]



Fig.4 SIM 900A GSM MODULE (5V)

LED

A light-emitting diode (LED) is a semiconductor device that generates light when an electric current pass through it (as seen in Fig. 5). Light is produced when current-carrying particles (electrons and holes) clash within the semiconductor material.

Because light is generated inside a solid semiconductor material, LEDs are solid-state devices. Organic LEDs (OLEDs) are classified as "solid-state lighting," which distinguishes them from other types of illumination that use heated filaments (incandescent and tungsten halogen lamps) or gas discharge (fluorescent lamps). [14]

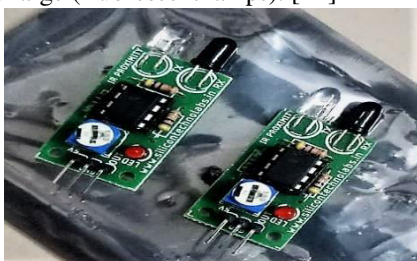


Fig.5 LED

LCD

This is a flat panel display that takes use of liquid crystal properties. LCD displays do not emit light directly; instead, single-color images are created via a backlight. LCD

displays may be found in television sets, computer monitors, and instrument panels, among other things. On each of its two lines, a 16 X 2 LCD can show 16 characters per line. In this display, each character is represented by a 577-pixel matrix. The two most significant registers on this LCD are as follows: (as shown in Fig.6)

- The LCD receives a command from the microcontroller, which is recorded in the command register.
- Data Register: The data that will be shown on the LCD is saved in the data register. The ASCII value of the characters that will be shown shows on the LCD panel. [15]

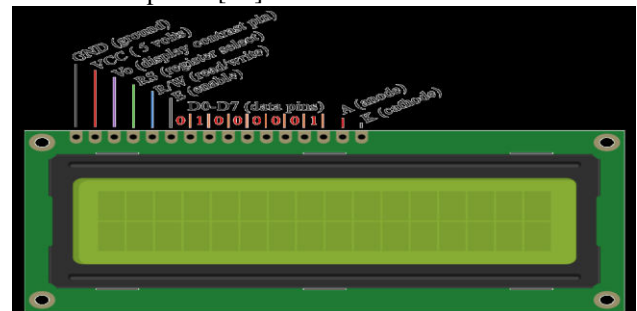


Fig.6 LCD

ULTRASONIC SENSOR

The ultrasonic sensor used to monitor the trash level within the rubbish bin is shown in Figure 7 (a). Figure 7 (b) demonstrates that when the garbage bin is completely full, an automatic communication is sent to the appropriate authorities with the location of the waste collection. That means the government won't have to travel around collecting rubbish every day, saving time and fuel for automobiles while also minimising the use of labour in vain. According to the preceding description, the proposed waste management system is considerably more efficient than the old trash management technique. [16]

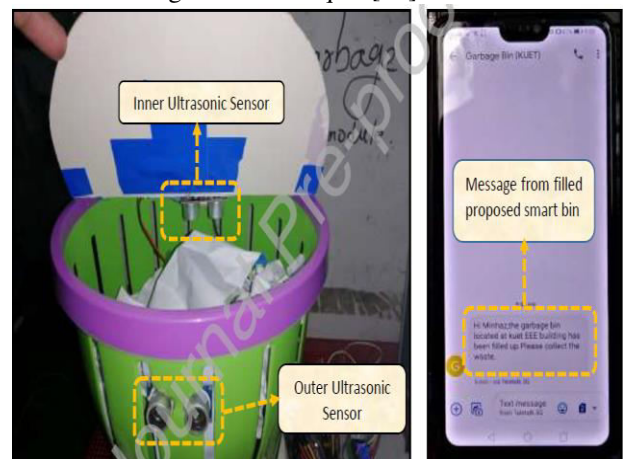


Fig.7 (a & b) Ultrasonic Sensor

MOISTURE SENSOR

As the name implies, this sensor is used to determine the

moisture content of a certain material. These sensors, which rely on other properties such as electrical resistance and dielectric constant, use the volumetric water content indirectly. In most cases, the sensor generates a voltage proportional to the dielectric permittivity and therefore detects the moisture content of a substance. (as seen in Fig.8) [15]

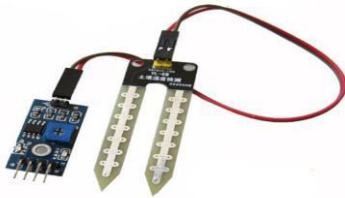


Fig.8 Moisture Sensor

Buzzer

The piezoelectric buzzer creates a sound via the piezoelectric effect of piezoelectric pottery and a pulse current which causes a metal plate to vibrate. A piezoelectric buzzer is composed of a multi-resonator, piezoelectric plate, an impedance match, a resonance box and other elements. There are also light emitting diodes in certain piezoelectric buzzers. The multi-resonator consists of transistors or integrated circuits. When power is activated, the multi-risk oscillates and creates an audio output of 1.5-2.5 kHz (1.5-15V DC operational voltage). The piezoelectric plate is driven to generate a sound by the impedance match. Silver electrodes are coated on both sides of the piezoelectric plate, which is composed of lead zirconated titanite or lead magnesium niobite piezoelectric ceramic. The silver electrodes are glued together with brass or stainless-steel sheets after they have been polarized and aged. (as seen in Fig.9) [17]



Fig.9 Piezo Buzzer

Servo Motor

Also called a rotative or linear actuator is a servomotor. It is used to govern extreme precision angled and linear position, speed and acceleration. It features a sufficient engine and a feedback sensor in the location. (as seen in Fig. 10) [18]

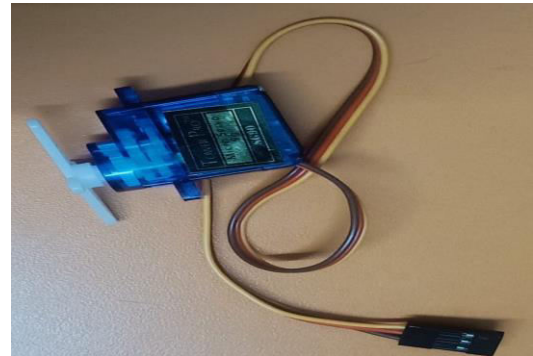


Fig.10 Servo Motor

CIRCUIT DIAGRAM

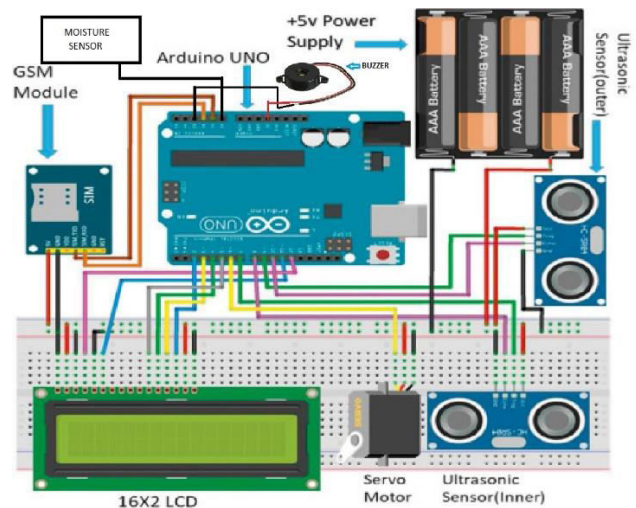


Fig.12 Circuit Diagram

In the above shown figure (Fig.12) Circuit Diagram here we have shown all the component that we have used in our project and is also the simulation method of the working of the same project.

APPLICATION:

- It cleans the surrounding efficiently.
- Reduces greenhouse gas intensity, such as methane, carbon monoxide, which is produced from collected trash.
- The primary benefits of automated waste bins are saving you time since each time you dump rubbish, you do not have to remove a lid. In fact, it helps limit the interaction with the germs, bacteria and parasites contained in the trash. This sort of bin is sanitary.
- It is useful for recycling of dry waste in an easy manner.
- Reduce garbage collection by up to 80%, leading to lower workforce, emissions and fuel usage and congestion in traffic. The number of garbage containers necessary is reduced. Analytical data for more effective management of collection routes and placement of containers.

- It has screen play which help to check the limit of dustbin.
- It's also good in fragrance because its separate the waste and it not create the unwanted germs and bad smell.
- It takes less space.
- It is so balanced machine for future for long period time.

CONCLUSION

By dumping trash, a system for automated waste segregation has been effectively built and tested. Metal, biodegradable, and nonbiodegradable trash are all precisely separated by the technology. The conveyor model is one of a kind in that it allows for the smooth passage of rubbish and aids in the disposal of waste into the appropriate containers. The IoT-enabled system uses a controlled software to monitor the entire operation. The data collected by the sensors was successfully uploaded to the cloud for further analysis. By separating recyclable and non-recyclable trash, the method aids and saves the environment. The system is useful as a resource for waste separation, which benefits and protects the environment. The method allows for simple and quick recycling of waste materials. Essentially, the suggested technology aids smart cities in collecting trash containers on schedule around the city. It enables city dwellers to live under sanitary circumstances. It also rids cities of the noxious odours emanating from garbage cans. It's used to distinguish between moist and dry trash. With the aid of an SMS alert, it is possible to track the full waste bins around the city. If the filled bins are not collected within the specified period, a second SMS warning will be issued to government authorities expressing their dissatisfaction with their actions.

REFERENCE

- [1] <https://www.downtoearth.org.in/blog/waste/india-challenges-in-waste-management-56753>
- [2] "Municipal solid waste: Is it garbage or gold?" *UNEP Global Environmental Alert Service (GEAS)*, October 2013
- [3] K. Silpa, L. Yao, P. Bhada- Tata, and Frank Van Woerden, "What a Waste 2.0: A Global Snapshot of Solid Waste Management to 2050," *Urban Development Series*, Washington, DC: World Bank, 2018. 10.159/978-1-4648-1329-0
- [4] <http://www.ijres.org/papers/Volume-9/Issue-1/4/B09011316.pdf>
- [5] <https://www.instructables.com/L293D-Motor-Driver/> (accessed on 28/11/2020)
- [6] M., Mr. P. Y., and Ms. P. S. S. "Smart Garbage Monitoring System." *International Journal on Integrated Education*, vol. 1, no. 1, 2018, pp. 71-76.
- [7] N, S., Fathima, P. M., R, R., & Prakash, K. (2019). Smart Garbage Segregation & Management System Using Internet of Things (IoT) & Machine Learning (ML). 2019 1st International Conference on Innovations in Information and Communication Technology (ICIICT). doi:10.1109/iciict1.2019.8741443
- [8] Reddy, A. A., Gangadhar, B., Muthu Kumar, B., & Mayan, J. A. (2019, October). Advanced Garbage Collection in Smart Cities Using IoT. In *IOP Conference Series: Materials Science and Engineering* (Vol. 590, No. 1, p. 012020). IOP Publishing.
- [9] Kulkarni, D., Mahendrakar, A., Molak, O., Kumar, S., & Chitnis, P. (2020). Smart Waste Bin. Akshay and Molak, Omkar and Kumar, Shivam and Chitnis, Piyush, Smart Waste Bin (April 27, 2020).
- [10] Goel, M., Goyal, A. H., Dhiman, P., Deep, V., Sharma, P., & Shukla, V. K. (2021, March). Smart Garbage Segregator and IoT Based Waste Collection system. In *2021 International Conference on Advance Computing and Innovative Technologies in Engineering (ICACITE)* (pp. 149-153). IEEE.
- [11] Kannan, A. (2021). IoT Based Smart Garbage and Clearance System. *Available at SSRN 3819617*.
- [12] <https://store.arduino.cc/usa/arduino-uno-rev3>
- [13] [https://www.circuitstoday.com/interface-gsm-module-with-arduino#:~:text=A%20GSM%20Module%20is%20basically,a%20PC%20\(personal%20computer\).](https://www.circuitstoday.com/interface-gsm-module-with-arduino#:~:text=A%20GSM%20Module%20is%20basically,a%20PC%20(personal%20computer).)
- [14] <https://www.ledsmagazine.com/leds-ssl-design/materials/article/16701292/what-is-an-led#:~:text=In%20the%20simplest%20terms%20a,together%20within%20the%20semiconductor%20material>
- [15] <https://www.electronicshobby.com/2018/10/arduino-based-automated-waste-segregator-final-year-project.html>
- [16] <https://www.fierceelectronics.com/sensors/what-ultrasonic-sensor#:~:text=An%20ultrasonic%20sensor%20is%20an,sound%20that%20humans%20can%20hear.>
- [17] <https://www.quisire.com/blog/faq/what-is-the-working-principle-of-the-buzzer>
<https://en.wikipedia.org/wiki/Servomotor#:~:text=A%20servomotor%20is%20a%20rotary,a%20sensor%20for%20position%20feedback.&text=Servomotors%20are>