

# TRASH MONITORING SYSTEM USING MICROCONTROLLER

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**ABSTRACT:**

Waste production has increased as urbanization spread swiftly. In the existing crisis, people are having a lot of trouble managing and collecting trash. Garbage can overflow and harm the environment and pose several issues for the local population. Locating the trash cans is challenging, regardless of whether they are full or not. Hence, to address this issue and save time while also preventing environmental contamination, we have introduced our project. The primary goal of our project is to use this technology to automatically determine the level of cans and deliver messages through the Telegram app. The Ultrasonic sensor will be used in our project to help us detect the level in the trash cans. The information from the Arduino Uno is delivered as input to the Wi-Fi module, which communicates with the authorized person and cooperation employees.

**Keywords:** Arduino UNO, Trash cans, Ultrasonic, IOT, VM ware

## 1. INTRODUCTION

The world's overpopulation may cause a rise in waste. Due to less waste being collected, transported, and disposed of, people are facing significant environmental challenges. As a result, waste management is becoming a big issue. Cities produce more trash than villages, which causes the environment to become polluted and has an impact on public health. By implementing our project "Trash Monitoring" into practice, all of the aforementioned issues can be resolved. If there is waste in public areas, employees of the company will be notified to clean the specific area. They will therefore find it useful to know whether the trash cans are fully or partially filled. Workers can regularly collect waste to maintain a neat environment with the use of a trash detecting system. Nowadays waste management is becoming more a problem every day in both developed and emerging countries as a result of the rapid pace of urbanization. Rapid urbanization and industry headway have changed the characteristics of solid waste. To fit the current trash amount and strong solid waste administration procedure should be updated. This suggested framework is prepared to reduce the cost of advancement. The project uses an Ultrasonic sensor, a Wi-Fi module, Arduino UNO, and a Telegram app to send messages to the authorized person.

## 2. ULTRASONIC SENSOR

Ultrasonic sensor make use of ultrasonic waves which humans cannot hear to detect the existence of objects or the distance between the objects. These high frequency sound waves are transmitted by the sensor that passes through the air and hits the object. This sound wave bounces back and are received by the sensor. Now the sensor calculates the distance from the time taken for the sound waves to bounce back to the sensor.

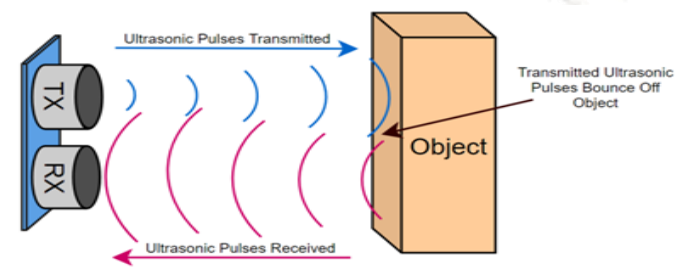


Fig., 1 Ultrasonic sensor model

Fig., 2 Working of Ultrasonic sensor

$$\text{Distance} = (\text{Speed of Sound} \times \text{Time taken by ultrasonic wave to travel}) / 2 \tag{1}$$

Where

- Speed of Sound = 343 meter per second (m/s)
- Time taken by ultrasonic wave to travel = Time taken for the ultrasonic waves to hit the object and return to the sensor. It is measured in milliseconds (ms) or microseconds ( $\mu$ s).

The sound waves which are transmitted by the sensor, are reflected by the object and then reaches the sensor. So the distance calculated is divided by two.

For example: If the sound waves are transmitted from a sensor to hit an object and the time taken for the waves to hit and get reflected back to the sensor is 0.025 seconds. Then the distance between the sensor and the object is obtained as:

$$\text{Distance} = (343 \times 0.025) / 2 \text{ meter} \quad (2)$$

### 3. ARDUINO UNO

The Arduino Uno is a widely used microcontroller board that is based on the ATmega328P microcontroller chip. It features 14 digital input/output pins, 6 analog inputs, a 16 MHz quartz crystal, a USB connection for programming and power, and a power jack, making it a versatile and user-friendly option suitable for both novice and experienced users. The board can be programmed with ease using the Arduino Integrated Development Environment (IDE), a software tool that is user-friendly and enables users to write and upload code. Moreover, the programming language used by Arduino Uno is based on C++ and is straightforward to learn, even for individuals without programming experience. Furthermore, the board does not have any special requirements, making it easy to operate.

Arduino Uno is composed of several key components, each with its own function:

**Microcontroller:** The ATmega328P microcontroller chip functions as the central processing unit of the board, governing all of its operations.

**Digital input and output pins:** The board comprises 14 digital input/output pins, capable of interfacing with a range of sensors, actuators, and components. These pins can be programmed as inputs or outputs, as per the project's requirements.

**Analog input pins:** The board also features that there are 6 analog input pins that can read analog signals such as temperature and light levels.

**USB connection:** The USB connection is used for programming and power, allowing the board to be powered and programmed using a USB cable connected to a computer.

**Power jack:** The board can be powered using an external power supply through the power jack.

**Reset button:** This reset button is used to reset the board, which is useful for restarting a program or uploading new code.

**Crystal oscillator:** The 16 MHz quartz crystal provides precise timing for the board. **Voltage regulator:** The voltage regulator regulates the voltage of the power supply to a level that the board can use. **LED indicators:** The board includes several LED indicators, including power indicator, TX and RX indicators, and a built-in LED on pin 13. These LEDs provide visual feedback on the status of the board.

When the board is powered on or reset, the microcontroller chip runs a bootloader program that checks for a new sketch to be uploaded via the USB connection or from the onboard memory. If a new sketch is found, it is uploaded and the board starts running the new program. The program on the board controls the input/output pins, which can be used to read sensor data or control actuators such as motors, LEDs, and displays. The program runs in a loop, continually reading sensor data and responding to changes in input signals by executing the appropriate code. The board communicates with the computer via the USB connection, allowing the user to upload new sketches and receive serial data output from the board. This communication is made possible by a USB-to-serial converter chip on the board, which translates the USB signals to serial signals that can be understood by the microcontroller.

Overall, Arduino Uno works by running a program on the microcontroller chip, which interacts with the input/output pins and communicates with the computer via the USB connection.

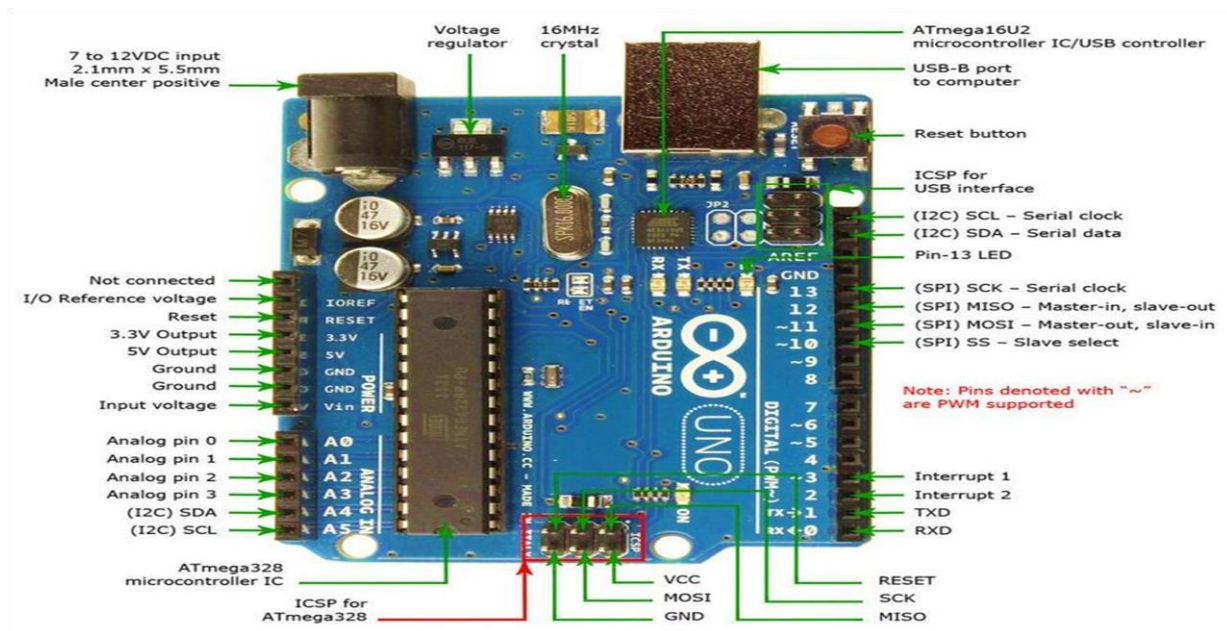


Fig., 3 Pin Diagram of Arduino UNO

#### 4. THE WIFI MODULE

The market has introduced the Wi-Fi MODULE ESP-12E, which is a compact module that serves as an interface between a microcontroller or central processing unit (CPU) and a wireless network connection. It has the ability to function as an independent application or to integrate Wi-Fi capabilities into computers. It is an affordable method of producing Internet of Things (IoT) applications. The ESP-12E is used to connect a microcontroller to a wireless network and is easy to use due to its simple circuitry. The ESP-12E belongs to the ESP-XX series, which are all ESP8266 based but differ in flash memory, output ports, and antenna type. These modules, ranging from ESP-01 to ESP-15, provide an excellent solution and are frequently used by engineers to establish wireless communication between two applications. These modules are ideal for IoT and data sharing.

#### CHARACTERISTICS:

- Frequency Range: 2.412 - 2.484 GHz
- Wireless Standard: IEEE 802.11 b/g/n protocol.



Fig., 4 Wi-Fi Module ESP-12E

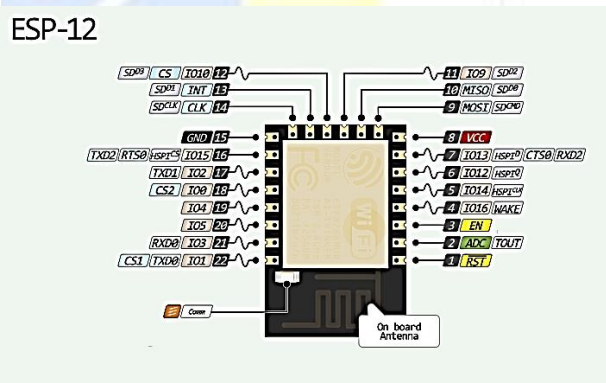


Fig., 5 Pin Diagram of ESP-12E

## 5. LITERATURE SURVEY

## 1. SMART GARBAGE SYSTEMS USING THE INTERNET OF THINGS

The study focused on the use of infrared and ultrasonic sensors for automatic lid opening and closing, as well as level detection, to ensure hygienic and healthier waste disposal. The research findings suggest that residents can reduce their trash by adopting an adaptable user-oriented charging policy, while web-based services can improve the efficiency of waste disposal and collection operations. The study proposes a system for monitoring solid waste cans, where a garbage can is placed in a public area and a camera is installed to capture its location. The garbage can is monitored through video surveillance, GPS, GIS, and RFID technologies, which transmit images to a workstation. The study provides a comprehensive analysis of the implementation of intelligent methods in waste management models, highlighting the significant role of this technology in modern garbage management systems. The researchers conclude that this technique is highly beneficial in monitoring the status of trash cans and preventing them from overflowing onto the streets.

## 2. DEVELOPING IOT FOR EFFICIENT SOLID WASTE MANAGEMENT IN INDIAN CITIES

The term "Internet of Things" (IoT) refers to a network that utilizes sensing devices to facilitate communication and information exchange, enabling intelligent positioning, awareness, control, monitoring, and detection. A recent study has been proposed by researchers to explore the potential of IoT-based solid waste management systems. Such systems offer time-efficient methods for municipal corporations to remotely monitor the status of dustbins through a web server, contributing to the maintenance of cleanliness in cities. The researchers have developed a practical IoT-based system for the collection and management of solid waste in smart cities. This system includes an automatic and beneficial dustbin monitoring system, enhancing the efficiency of waste management. Furthermore, the researchers have designed a mechanized sensing system utilizing a load cell and an ultrasonic sensor, which can accurately detect and monitor the fill levels of dustbins.

## 6. VMWARE WORKSTATION

The complete infrastructure virtualization package VMware Infrastructure offers integrated virtualization, management, optimized resources, more available applications and automation features. The underlying resources in physical hardware are virtualized and combined across several systems by VMware Infrastructure, which then gives the data center in the virtual environment pools of virtual resources. A collection of distributed services introduced by VMware Infrastructure also for allocating quality-driven resources, increased availability, fine-grained and the entire virtual data center backup is consolidated. With the help of these distributed services, an IT firm may efficiently set up and fulfil production Service Level Agreements with its clients. A free virtualization tool for Linux and Microsoft Windows servers is VMware Server. By dividing a real server into several virtual machines, customers can quickly provision more server capacity. VMware servers can be utilized to supply a large range of plug-and-play virtual appliances for infrastructure that is often used. Any standard x86 hardware is supported by the VMware Server. Many different operating systems, including 64-bit operating systems, for Linux, NetWare, Solaris, and Windows. There is no communication between machines or between them and the physical host. Transfer virtual machines without having to reconfigure from one physical host to another. By building and deploying customized virtual machines using the VMware Server Virtual Machine Wizard, you can speed up the provisioning process for new servers. If circumstances change, move virtual computers to alternative physical hosts.

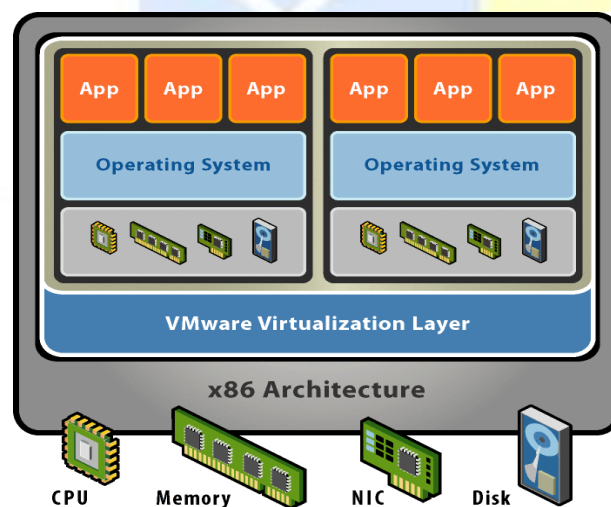


Fig., 6 VMware workstation

## 7. UBUNTU CODING PLATFORM

There were numerous Linux-based operating systems available, but none were user-friendly for the general public. Ubuntu Linux was created by South African businessman Mark Shuttleworth. Microsoft Windows gained popularity among computer users because it was known for being a user-friendly operating system. The objective of Mark Shuttleworth was to create a straightforward, Linux-based operating system for the entire community. He founded a company called Canonical. The Canonical firm initially began the Ubuntu operating system as a project. A practically free software project is the Ubuntu operating system. Due to its ease of use as compared to other Linux-based operating systems, Ubuntu has greatly increased in popularity. At every stage of Ubuntu development, there is community interaction. The word "Ubuntu" is derived from an African school of philosophy. Ubuntu's basic tenet is "Humanity towards others." On October 20, 2004 Ubuntu Linux was initially made available on the internet, and it is made accessible for downloads. At that time Ubuntu CDs were supplied due to poor internet via postal mail.

## 8. TELEGRAM APP

A cloud-based, cross-platform instant messaging service is Telegram. In addition, the service offers several capabilities, including VOIP, end-to-end encrypted video calling and file sharing. On August 14 2013, it was made available for download to iOS users, and in October of the same year, android users could do the same.

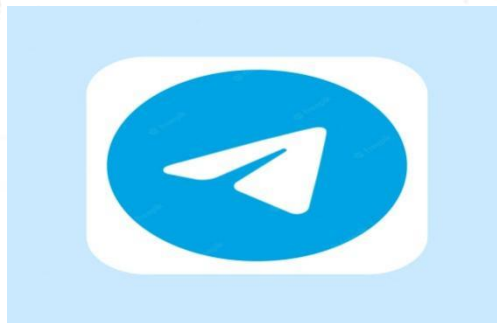


Fig., 7 Telegram App Symbol

## 9. CONCLUSION

Our prototype of a realistic waste can serves as an efficient and eco-friendly solution to the problem of overflowing trash, benefiting people worldwide. The primary objective of this model is to ensure a waste-free environment and mitigate the risk of trash cans spilling over. In larger cities, the garbage collection vehicle visits the area twice or thrice a week, depending on the population. However, the waste bins may not always be filled to their maximum capacity. Our approach provides real-time information on the status of each dustbin, enabling the concerned authorities to dispatch the litter collection vehicle only to the bins that require attention. This technique not only saves fuel but also contributes to creating a greener and cleaner environment. The current implementation is limited to a single canister, with the ability to unify multiple cans each having a unique ID. The system is powered by a 12v power unit and does not include a dry and wet waste separation facility. The future scope of this implementation may incorporate a compressor for compressing the waste and a solution for separating dry and wet waste.



Fig., 8 Output of Proposed System

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