

# A GARBAGE WASTE AND TOXIC ENVIRONMENT MONITORING USING IOT

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**Abstract** -An “A Garbage Waste and Toxic Environment Monitoring” has been designed which includes an electronic waste detection device and a central control unit. An infrared sensor for sensing waste levels, GPS for location identification, Arduino Board having a microcontroller and GSM Module for sending the message containing the information regarding waste bin being is full or empty. MQ 2 sensor is used to detect the various gas. The central control unit comprises of a receiving device which receives a message from the waste detection device via a GSM Module and sends it to the computer software via a USB cable using Arduino Board’s microcontroller. The software has a proficiently designed GUI which enables the user to perform and monitor all the required actions for waste monitoring and detection in the waste bins placed in an area or a city. All the information like latitude, longitude, the status being full or empty etc. are displayed in the GUI of the software in the event of a waste-bin getting full and then being emptied by municipal waste trucks or field workers. Therefore, all the components in this overall system work in an intelligent manner to make automated waste management possible so that the waste is collected and disposed to the dumping sites only when it is necessary at a proper time. This work mainly focuses on timely and automatic waste collection and transportation mechanism. The proposed system is to monitor harmful gases like Carbon Monoxide, Methane, Hydrogen, Flammable gases using sensors. When the criterion level go beyond the threshold limit an alert message will be send to the user using GSM.

**Key Words:** Arduino, GSM Module, MQ 2, GUI, Carbon Monoxide, Methane, Hydrogen, Flammable gases

## 1. INTRODUCTION

### 1.1 GENERAL

Learn cleanliness from the cat is said and appreciated in society. The scenario beyond this proverb is that keeping the environment clean is quite important and it is used to emphases more on giving attention to the cleanliness. Nonetheless, it is not as easy as to speak out the proverb to effectively and properly managing the garbage.

We frequently observe garbage bins being filled over and additional waste materials being disposed and accumulated around the bin in different cities. Those improperly disposed garbage will be the dwelling for various number of dangerous micro-organisms, insects and mosquitoes to breed on. Because of this, severe and contagious disease is stimulated and also bad smell comes out of it and may cause illness to human beings. Toxic gases are one that causes serious health impacts, but are also used in industries in large quantities.

### 1.2 AUTOMATION

Automation is the technology by which a process or procedure is performed with minimal human assistance. Automation or automatic control is the use of various control systems for operating equipment such as machinery, process in factories, boilers and heat treating ovens, switching on telephone networks, steering and stabilization of ships, aircraft and other application and vehicles with minimal or reduced human intervention. Automation covers applications ranging from a household thermostat controlling a boiler, to a large industrial control system with tens of thousands of input measurements and output control signals. In control complexity, it can range from simple on-off control to multi-variable high-level algorithms.

### 1.3 INTERNET OF THINGS

The Internet of Things is transforming the way enterprises manage assets and run operations. The enormous data that is harnessed is fueling innovation in every aspect from optimization in manufacturing processes, service delivery mechanisms to creating newer business models. Web NMS enterprise IoT Platform enables your enterprise to harness the power of IoT to connect a diverse set of assets, operations, and systems to enable data driven decisions. WebNMS IoT Platform is a sophisticated application enablement platform that comes pre-built with functionality such as data acquisition from edge, analytics and storage, escalations and remote action triggers, visualization and reporting, device management, user management and security. With complete support for Energy Management, Remote Asset

Management and Logistics and Fleet Management, the platform addresses most enterprise IoT application needs and integrates seamlessly with 3rd party enterprise applications, enabling true digital transformation. The Internet of Things (IoT) is a system of interrelated computing devices, mechanical and digital machines, objects, animals or people that are provided with unique identifiers (UIDs) and the ability to transfer data over a network without requiring human-to-human or human-to-computer interaction.

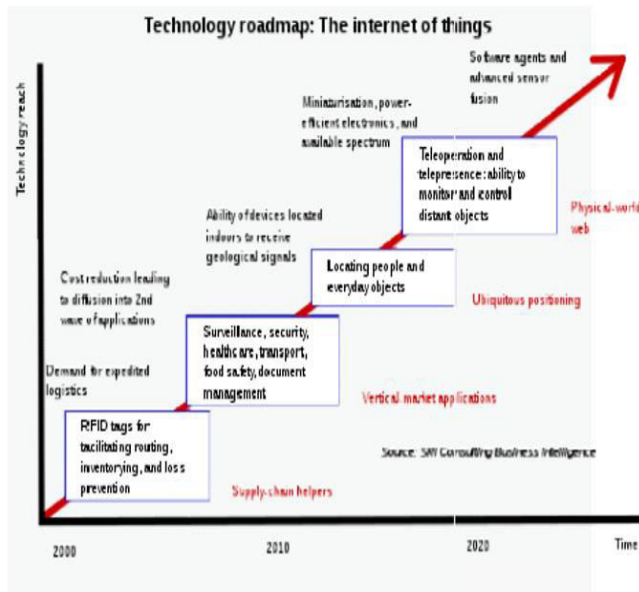


Fig -1: Technology roadmap: Internet of Things

The definition of the Internet of Things has evolved due to the convergence of multiple technologies, real-time analytics, machine learning, commodity sensors, and embedded systems. Traditional fields of embedded systems, wireless sensor networks, control systems, automation (including home and building automation), and others all contribute to enabling the Internet of Things.

In the consumer market, IoT technology is most synonymous with products pertaining to the concept of the "smart home", covering devices and appliances (such as lighting fixtures, thermostats, home security systems and cameras, and other home appliances) that support one or more common ecosystems, and can be controlled via devices associated with that ecosystem, such as smartphones and smart speakers.

## 2. PROPOSED ALGORITHM

This paper describe Vehicle Trip Counting System (VTCS) is used for recording the amount of waste collected from the waste bins and transferred todumping sites. The installation of VTCS has been done on weighbridges where a picture of the transferred to dumping sites. The vehicle can show the amount of waste collected by every vehicle in real time. The installation of trackers has been done on all functioning trucks as well as vehicles of contractors to manage a flotilla of 600 functioning vehicles proficiently.

Route of vehicles, travel speed, covered distance; stopping parking points of vehicles etc. are tracked by Vehicle Tracking and Monitoring System (VTMS). The main objective of this project is to detect the toxic gases while cleaning the drainage. During the cleaning process the toxic gases like nitrogen oxide, carbon monoxide and other gases are emitted. It can be detected by different sensors and indicated to alert the users and also a warning message is send to the base station to make the safety measures to the workers from the effect of toxic gases. Hence the system will help to solve the problem while cleaning the drainage.

### 2.1. HARDWARE DESIGN

An electronic waste detection device has been designed to be deployed at the location of the waste bin. The components which have been used and interfaced together in the device are an IR sensor obstacle detection module, a SIM900D GSM module, a u-blox 6 GPS module and an Arduino Nano board based on ATmega328. The power to the device has been supplied with a battery bank. The transmission of an infrared signal is the fundamental concept of an IR sensor where it is used in obstacle detection. The transmitted IR signal then strikes the object to be detected and then the IR receiver receives the respective signal. By using this principle, the IR sensor module senses and detects the waste levels in the respective waste bin. The IR sensor module is deployed close to the top of the waste bin. The sensor is activated in the event of the waste bin getting full to a certain level and also after the waste bin is being emptied. Then a message is generated which is transmitted by GSM-RF module containing the information regarding the full or f status and location of the waste bin which is provided by the GPS deployed in the detecting device. All of these functions are controlled by microcontroller ATmega328 embedded on Arduino Nano module. A device named as central control unit device is placed at the receiver. The device has a SIM900 GSM module connected to Arduino Mega board based on ATmega2560 which receives that message. This device has been interfaced with the laptop using USB port communication. The status of the bin as empty or full and the location in terms of latitude and longitude in the received message is then shown on the UI in the main control unit software. The MQ2 sensor is used to the various gas detection. Figure shows the block diagram of the overallsystem.

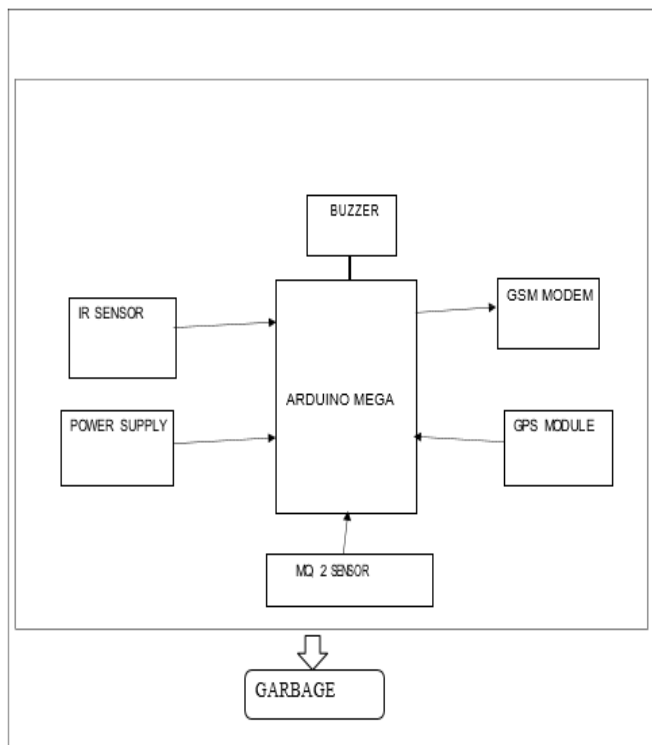


Fig -3: Block Diagram

The toxic gases like carbon monoxide, methane, hydrogen sulphide which is emitted from the drainage wastes. While cleaning the drainage these gases are emitted. The emitted gases are inhaled by the workers in drainage cleaning and it causes a major health effects. The effects like skin allergies, nervous system blockage, apnoea etc. These toxic gases which give these effects based on their concentration in drainage wastes. If the gas concentration are more than the threshold value it may cause to death also. Hence these gases are sensed by the different sensors and it should be given to the microcontroller to alert the workers by alarm indication. If the sensor value is greater than the threshold value the microcontroller gives the signal to alarm to indicate the warning to labours. This system will help to keep the workers from the effect of toxic gases.

## 2.2 INFRARED SENSOR

An infrared sensor is an electronic instrument that is used to sense certain characteristics of its surroundings. It does this by either emitting or detecting infrared radiation. Infrared sensors are also capable of measuring the heat being emitted by an object and detecting motion. Infrared technology is found not just in industry, but also in everyday life. For example, Televisions, it use an infrared detector to interpret the signals sent from a remote control. Passive Infrared sensors are used for motion detection systems, and LDR sensors are used for outdoor lighting systems. The key benefits of infrared sensors include their low power requirements, their simple circuitry and their portable features.

## 2.3 POWER SUPPLY

A power supply is an electrical device that supplies electric power to an electrical load. The primary function of a power supply is to convert electric current from a source to the correct voltage, current, and frequency to power the load. As a result, power supplies are sometimes referred to as electric power converters. Some power supplies are separate standalone pieces of equipment, while others are built into the load appliances that they power. Examples of the latter include power supplies found in desktop computers and consumer electronics devices. Other functions that power supplies may perform include limiting the current drawn by the load to safe levels, shutting off the current in the event of an electrical fault, power conditioning to prevent electronic noise or voltage surges on the input from reaching the load, power-factor correction, and storing energy so it can continue to power the load in the event of a temporary interruption in the source power.

## 2.4 BUZZER

A buzzer or beeper is an audio signalling device, which may be mechanical, electro-mechanical, or piezoelectric (piezo for short). Typical uses of buzzers and beepers include alarm devices, timers, and confirmation of user input such as a mouse click or keystroke.



Fig -3: Buzzer

## 2.5 ARDUINO MEGA

Arduino is an open-source hardware and software company, project and user community that designs and manufactures single-board microcontrollers and microcontroller kits for building digital devices. Its products are licensed under the GNU Lesser General Public License (LGPL) or the GNU General Public License (GPL) permitting the manufacture of Arduino boards.



rdsandsoftware distribution by anyone. Arduino boards are available commercially in preassembled form DIYkits.



**Fig -4:** Arduino Mega

Arduino board designs use a variety of microprocessors and controllers. The boards are equipped with sets of digital and analog input/output (I/O) pins that may be interfaced to various expansion boards or breadboards (shields) and other circuits. The boards feature serial communications interfaces, including Universal Serial Bus (USB) on some models, which are also used for loading programs from personal computers.

The microcontrollers can be programmed using C and C++ programming languages. In addition to using traditional compiler tool chains, the Arduino project provides an integrated development environment (IDE) based on the Processing language project. The Arduino project started in 2005 as a program for students at the Interaction Design Institute Ivrea in Ivrea, Italy, aiming to provide a low-cost and easy way for novices and professionals to create devices that interact with their environment using sensors and actuators. Common examples of such devices intended for beginner hobbyists include simple robots, thermostats and motion detectors.

## 2.6 GSM MODEM

A GSM modem is a specialized type of modem which accepts a SIM card, and operates over a subscription to a mobile operator, just like a mobile phone. From the mobile operator perspective, a GSM modem looks just like a mobile phone. When a GSM modem is connected to a

computer, this allows the computer to use the GSM modem to communicate over the mobile network. While these GSM modems are most frequently used to provide mobile internet connectivity, many of them can also be used for sending and receiving SMS and MMS messages.

**Fig -5:** GSM modem

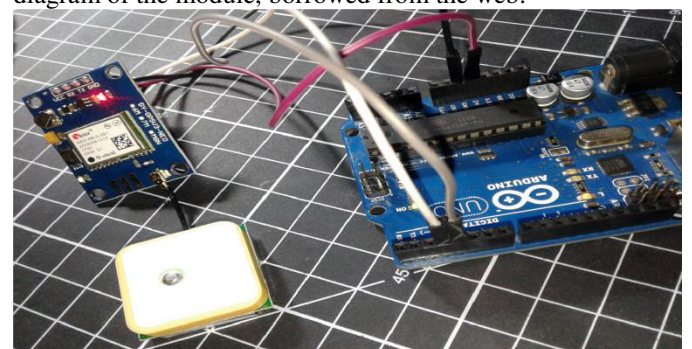
A GSM modem can be a dedicated modem device with a serial, USB or Bluetooth connection, or it can be a mobile phone that provides GSM modem capabilities. For the purpose of this document, the term GSM modem is used as a generic term to refer to any modem that supports one or more of the protocols in the GSM evolutionary family, including the 2.5G technologies GPRS and EDGE, as well as the 3G technologies WCDMA, UMTS, HSDPA and HSUPA. A GSM modem exposes an interface that allows applications such as Now SMS to send and receive messages over the modem interface. The mobile operator charges for this message sending and receiving as if it was performed directly on a mobile phone. To perform these tasks, a GSM modem must support an “extended AT command set” for sending/receiving SMS messages, as defined in the ETSI GSM 07.05 and 3GPP TS 27.005 specifications.

## 2.7 MQ 2 SENSOR

The MQ-2 Gas sensor can detect or measure gasses like LPG, alcohol, propane, hydrogen, CO and even methane. The module version of the sensors comes with a Digital Pin, which makes this sensor to operate even without a microcontroller and that comes in handy when you are only trying to detect one particular gas. When it comes to measuring the gas in PPM the analog pin has to be used. The analog pin also TTL driven and works on 5v and hence can be used with most common microcontrollers.

## 2.8 GPS MODULE

The u-box NEO-6M GPS engine on these modules is quite a good one, and it also has high sensitivity for indoor applications. Furthermore, there's one MS621FE-compatible rechargeable battery for backup and EEPROM for storing configuration settings. The module works well with a DC input in the 3.3- to 5-V range. The original circuit diagram of the module, borrowed from the web.



**Fig -6:** GPSsetup

As indicated, the GPS modules are based on the u-box NEO-6M GPS engine. The type number of the NEO-6M is NEO-6M-0-001, and its ROM/FLASH version is ROM 7.0.3 (PCN reference UBX-TN-11047-1). The NEO-6M module includes one configurable UART interface for serial communication, but the default UART (TTL) baud rate here is 9,600. Because the GPS signal is right-hand circular-polarized (RHCP), the style of the GPS antenna will be different from the common whip antennas used for linear polarized signals. The most popular antenna type is the patch antenna. Patch antennas are flat, generally have a ceramic and metal body, and are mounted on a metal baseplate.

### 3. EXPERIMENT AND RESULT

#### 3.1 ARUDINO 1.6.13

Arduino is an open source microcontroller which can be easily programmed, erased and reprogrammed at any instant of time. Introduced in 2005 the Arduino platform was designed to provide an inexpensive and easy way for hobbyists, students and professionals to create devices that interact with their environment using sensors and actuators. Based on simple microcontroller boards, it is an open source computing platform that is used for constructing and programming electronic devices. It is also capable of acting as a mini computer just like other microcontrollers by taking inputs and controlling the outputs for a variety of electronics devices.

It is also capable of receiving and sending information over the internet with the help of various Arduino shields. Arduino uses a hardware known as the Arduino development board and software for developing the code known as the Arduino IDE (Integrated Development Environment). Built up with the 8-bit Atmel AVR microcontroller's that are manufactured by Atmel or a 32-bit Atmel ARM, these microcontrollers can be programmed easily using the C or C++ language in the Arduino IDE.

Unlike the other microcontroller boards in India, the Arduino boards entered the electronic market only a couple of years ago, and were restricted to small scale projects only. People associated with electronics are now gradually coming up and accepting the role of Arduino for their own projects. This development board can also be used to burn (upload) a new code to the board by simply using a USB cable to upload. The Arduino IDE provides a simplified integrated platform which can run on regular personal computers and allows users to write programs for Arduino using C or C++.

#### 3.2 ARDUINO PROGRAMMING

Arduino is a prototype platform (open-source) based on an easy-to-use hardware and software. It consists of a circuit board, which can be programed (referred to as a microcontroller) and a ready-made software called Arduino IDE (Integrated Development Environment), which is used to write and upload the computer code to the physical board. The key features are

1. Arduino boards are able to read analog or digital input signals from different sensors and turn it into an output such as activating a motor, turning LED on/off, connect to the cloud and many otheractions.
2. You can control your board functions by sending a set of instructions to the microcontroller on the board via Arduino IDE (referred to as uploading software).
3. Unlike most previous programmable circuit boards, Arduino does not need an extra piece of hardware (called a programmer) in order to load a new code onto the board. You can simply use a USB cable.
4. Additionally, the Arduino IDE uses a simplified version of C++, making it easier to learn to program.
5. Finally, Arduino provides a standard form factor that breaks the functions of the micro-controller into a more accessible package.

The Arduino software is open-source. The source code for the Java environment is released under the GPL and the C/C++ microcontroller libraries are under the LGPL.

#### Initial test setup

For a quick test using your Windows computer, we just need to establish a serial communication with the GPS module using one USB-UART adapter like the PL2303 USB-to-Serial Converter module. The hardware setup is pretty simple:

**Table -1:** Initial test setup

NEO-6M GPS Module	USB-to-Serial Converter
TX	RX
RX	TX
GND	GND
VCC	5 V

Next, download and install the Windows PC debug/evaluation tool “u-center”. After successful installation, run the software (and the hardware) setup to transfer positioning data collected by the NEO-6M GPS module to the u-center software so that it can clearly display GPS data/information on the screen.

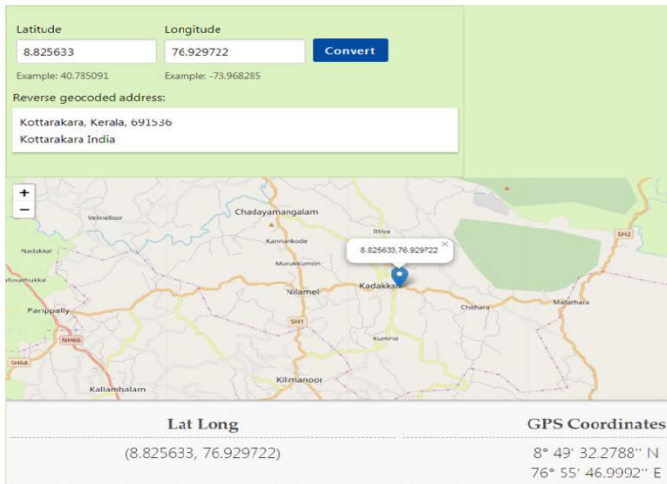


Fig -7: GPS data/information screen

### 3.3 HARDWARE OUTPUT

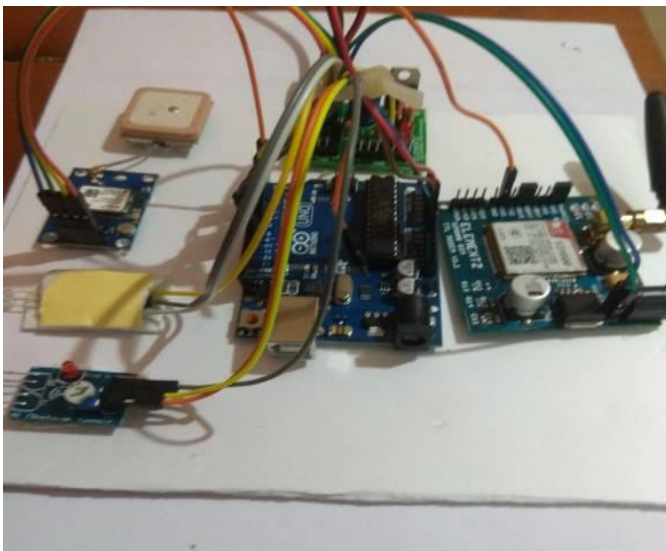


Fig -8: Hardware Kit

### 3.4 APPLICATION

- Municipal operations
- Urban operations
- Drainage cleaning
- Deeper coordination between public sectors – private sectors willingness to engage with regional, state agencies to use IoT applications in waste management.

### 3.5 ADVANTAGES

- Easy to manage cleanness.
- Single point of control in many cities.
- Effective information in cleanness unit like municipalities.

## 4. CONCLUSION

The garbage Waste and toxic environment monitoring System is a good step in the direction of making the overall waste collection and various dangers gas management situation in a lot better in terms of saving overall costs and time. The use of technologies like a sensor node, wireless communication and computer software means that the system designed could easily be integrated with the existing IT systems used by LWMC and its sub-contractors. More advantages include route optimization of the waste collection trucks, scheduling of collection process, less fuel usage and timely collection. So, all the components in this overall system work in an intelligent manner to make automated waste management possible so that the waste is collected and disposed to the dumping sites only when it is necessary and also at a proper time. That results in dealing with the problem of trash spreading on the streets and roads which will have a pleasant effect on the overall health of our society and will also minimize the environmental pollution caused by it. The AWCMS software is also connected to the internet for location identification of the filled-up waste bin and the location can easily be seen on Google Maps using the facility of internet. In this project I successfully completed the design of the toxic gas detection .The methane sensor was sensed the gas. The carbon monoxide sensor was successfully sensed the gas .when detecting the gas by the sensor and its value was exceeded from the threshold value the alarm was indicated and it alerted successfully. When the threshold value is reached the warning message was sent successfully to the base station.

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