Solid Waste Monitoring using IoT

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Abstract - *Waste management is a method of treatment of solid waste which includes its collection, transport, treatment & its disposal. The total waste generated is increasing by a large amount day by day. With the increase in population of mankind, it is expected to grow in ten-folds in the future. Managing such huge number of wastes is a global issue. In order to tackle this problem, we have developed a smart waste management for solid waste using IoT and Cloud Computing. In the proposed system, we have a developed a smart waste bin equipped with ultrasonic sensors which detects waste & gas sensor which detect the harmful greenhouse gases. Once the bin is full, this data is sent to the local municipal authorities. The data analytics of the waste is done through cloud. The citizens can also get real-time status of the waste through our mobile application thereby notifying the relevant authorities.*

Key Words: **Waste, IoT, Cloud Computing, Ultrasonic Sensor, Gas Sensor**

1. INTRODUCTION

Solid waste is nothing but trash items that are discarded by the people. They can be recyclable, non-recyclable, perishable, non-perishable, etc. Solid waste management is nothing but processing of such types of waste so that they can be disposed of safely. The largest waste in this planet is generated by human beings. The waste generated from different countries differ on the basis of total waste generated per year. Some areas produce more waste compared to other. Urban areas are more inclined to produce higher wastes than the rural areas. According to recent survey by World Bank Group [4], the annual waste generated worldwide is at least 2.01 billion tones and this number is expected to grow to 3.04 billion tones by 2050. In urban cities, as consumption of resources is more, the total waste generated is big too. The municipal corporation is set up for managing municipal waste. They collect the trash using pickup trucks once in a day. However, the waste bins are filled up in short periods of time. The trash starts to overflow. Due to this, the unattended waste bins release harmful greenhouse gases like CH_4(Methane) into the atmosphere. This is bad for the environment and overall hygiene of that particular area.

There is a need for a proper waste management system that fulfils the objective such as:

- Monitor the level of trash

- Detect the gas generated from the waste

- Alert the municipal authority of the status of the waste to take action

- Prioritize the areas which require the most attention for pickup.

2. LITERATURE SURVEY

The research on waste management has been carried out several times in the past and some are still in development. Even before technology came in to the picture, people were discussing on proper methods for treatment of solid waste. In paper [1], the concept of garbage bin monitoring and dynamic scheduling is implemented. It also includes cloud system for collecting data and organization of waste. In addition to this the location-based monitoring system is introduced in paper [2]. The status of the bins is shown on a website and the data collected is used for optimizing distribution of the containers. The GPS module used will be able to display in which location the bin requires the most attention. In paper [3], the toxicity of the waste is also detected by implementing the gas detection sensor. The Arduino Uno is interfaced between GSM/GPRS module and the sensors. The website displays the results of the bin level and the toxicity as well as an alert is sent to the mobile phones. Citizens can submit a complaint to address the situation on the website.

3. METHODOLOGY

In this project, we are using IoT (Internet of Things) along with cloud.

The following components are needed: 1. Arduino Uno microcontroller

2. Arduino Ethernet Shield

3.HC-SR04 Ultrasonic Sensor 4.MQ-4 Gas Sensor

Internet of Things (IoT): With the advent of modern sciences and technology, it is possible to automate certain tasks which could've not been possible earlier. We need to take full advantage of the resources that we have in order to reduce our workload thereby increasing efficiency. IoT or Internet of Things is a technology that can connect any physical device to the Internet which enables them for sharing information among another IoT enabled device.

Arduino Uno: It is a microcontroller board based on Microchip ATmega328p microcontroller developed by Arduino.cc. It has 14 digital pins and 6 analog pins. The Arduino IDE can be used to write programs for the board. The board can be powered by a type B USB cable or an external 9V battery. The analog and digital sensors can be operated using Arduino using respective pins.

Fig-1: Arduino Uno

Table - 1: Specifications of Arduino Uno [3]

Parameter	Specifications
Operating Voltage	5 Volt DC
Input Voltage	7-12 V
Clock Speed	16 MHz
DC current per I/O pin	40mA

Arduino Ethernet Shield: It is microcontroller board which allows to connect the Arduino board to the internet using Ethernet Library. It is connected to our Arduino Uno board to send data to Thingspeak.

Fig-2: Arduino Ethernet Shield

HC-SR04 Ultrasonic Sensor: HC-SR04 is the ultrasonic sensor used for this project. It is used to determine the distance of an object using sonar. The sensor emits a wave which is reflected back as soon as it comes in contact with an object in its path.

Fig-3: Ultrasonic Sensor

Table - 2: Specifications of Ultrasonic Sensor [3]

Parameter	Specifications
Operating Voltage	5 Volt DC
Operating Current	15 mA
Frequency of Operation	40 Hz
Range	2cm-400cm

MQ4 Gas Sensor: MQ4 is a semiconductor type gas detection sensor. It is mainly used for detecting natural gases like Methane. This is due to it being sensitive to CH4.

Fig-4: Gas Sensor

**Table -3:** Specifications of MQ4 Gas Sensor [3]

Parameter	Specifications
Operating Voltage	5 Volt DC
Heater Voltage	4.8V - 5.2V
Heater Resistance	28 ohm - 34 ohm
Load Resistance	20K ohm

Thingspeak: Thingspeak is open-source IoT application that allows us to store data from IoT enabled sensors in the form of API keys. We can also perform Data Analytics & Data Visualization in the form of bar graphs, charts, etc.

4. IMPLEMENTATION

In this project, we have used IoT and cloud to provide real- time status of the waste bin. It calculates the trash level and the presence of methane. The ultrasonic sensor and gas sensors are set below the lid of the bin. The Ultrasonic sensor detects the trash level by sending ultrasonic waves while the gas sensor detects the presence of CH4. This information is sent to the Arduino board. The Ethernet shield connected to the Arduino Board sends the data to Thingspeak (a cloud platform). The data analysis and visualization are carried out in the channel. This data can be accessed by the mobile application which shows the status of the bin.

Advantages of the system are: monitoring of garbage in real- time, less accumulation of waste, the amount of greenhouse gases released in the atmosphere is reduced, efficient use of resources, time-saving.
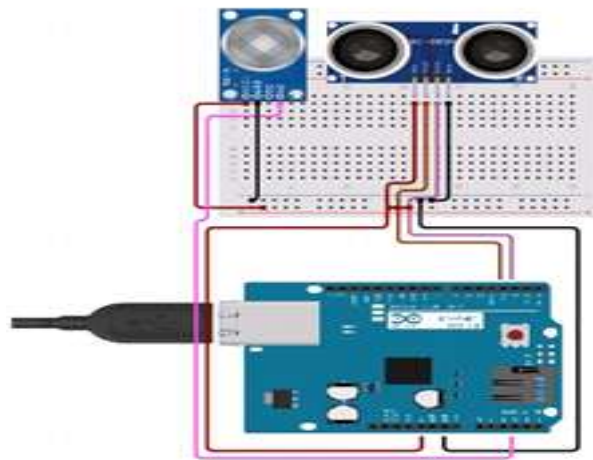
4.1 FLOWCHART
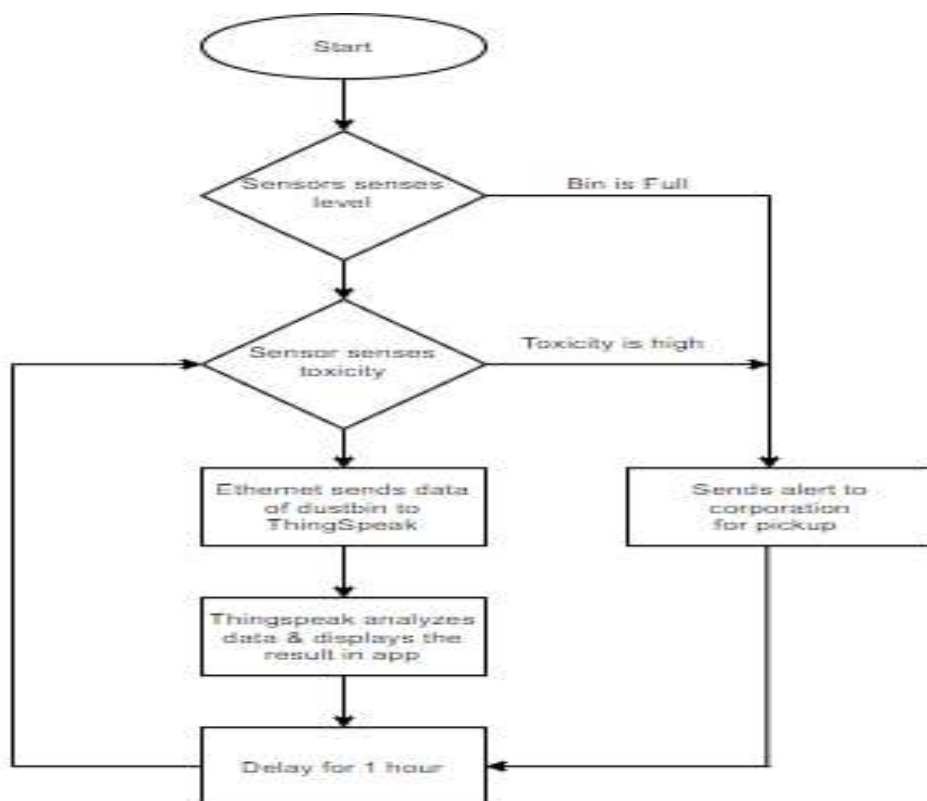
4.2 RESULTS

5. CONCLUSION & FUTURE WORK

A strong waste management system indicates a healthier ecosystem for living beings. Using technology and proper planning, the efforts required to efficiently manage waste is reduced with added alternatives. This system can be further improved by implementing a system that can automatically classify the type of waste for disposing the more hazardous ones and recycling the ones that can be done so.

6. REFERENCES

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