IOT-Based Garbage Monitoring System Using Weight Sensing

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Abstract- *Garbage pollution has a big impact on the environment. The current system of garbage management in many cities and towns is ineffective, which leads to environmental and health hazards. Densely populated areas with high footfall (commercial, public, and residential) face a major threat. The lack of efficient garbage management is not only harmful to the environment but also adversely affects the quality of the citizen's life. To address this problem, there is a need for a robust garbage monitoring system that can provide real-time information about the garbage levels in different areas and ensure prompt and efficient garbage collection.*

Keywords- IOT, Health hazard, pollution, Garbage Collection, Mart bins

I. INTRODUCTION

A garbage monitoring system is a technology-based solution that tracks and manages waste disposal processes. It typically uses various sensor devices as well as software applications to gather data and analyze waste collection, transportation, and disposal. This system aims to improve waste management efficiency by providing real-time information about the status of garbage bins, helping waste collection services optimize their routes, and reducing the impact of waste on the environment. With the implementation of a garbage monitoring system, municipalities and waste management companies can enhance their management operations, minimize costs, and promote sustainability. One of the main concerns with our environment has been solid waste management which impacts the health and environment of our society. The detection, monitoring, and management of waste are one of the primary problems of the present era. The garbage lying around the sides of the streets could quickly harbor rats and fleas that carry harmful diseases if the collection and disposal are not done appropriately. The traditional way of monitoring the waste in waste bins is a cumbersome process and utilizes more human effort, time, and cost which can easily be avoided with our present technologies.

A. Arduino Uno

Arduino Uno is a microcontroller board on the ATmega328P microcontroller. It is a popular board for prototyping and building digital devices and interactive objects that can sense and control the physical world. The board has 14 digital input/output pins, 6 analog inputs, a 16 MHz quartz crystal, a USB connection, a power jack, an ICSP header, reset button. The pins can be used to interface with sensors, actuators, displays, and other electronic components. The board can be programmed using the Arduino software, which is a cross-platform Integrated Development Environment (IDE) based on the Processing programming language. The software allows users to write and upload code to the board using a simple, easy-to-learn programming

Fig.1.Arduino Uno Microcontroller

B. Weight sensor

A weight sensor is a device that is used to measure the weight or force applied to an object. It is also known as a load cell or force sensor is shown in figure 2. The weight sensor converts the applied force into an electrical signal, which can be measured and analyzed using a variety of instruments, such as a digital display or computer. There are several types of weight sensors available, including hydraulic load cells, pneumatic load cells, strain gauge load cells, and piezoelectric load cells. The type of weight sensor used depends on the application and the level of accuracy required. Weight sensors are commonly used in a variety of industries, such as automotive, aerospace, food and beverage, and healthcare. They can be used to measure the weight of objects ranging from small components to heavy machinery, and they

are also used in medical equipment to monitor patient weight and movement.

Fig.2.Weight sensor

C. Ultrasonic sensor

An ultrasonic sensor is a device that uses high-frequency sound waves to measure distance or detect objects. The sensor emits ultrasonic waves, which bounce off objects and return to the sensor. By measuring the time, it takes for the waves to travel back to the sensor, the distance to the object can be calculated. Ultrasonic sensors are commonly used in robotics and automation, as they can detect objects without making physical contact. They are also used in parking assist systems in cars, distance measurement, and level sensing applications. Retro-reflective sensors use a reflector to bounce the ultrasonic waves back to the sensor. When an object passes between the sensor and the reflector, the waves are not reflected back, and the sensor detects the presence of the object. Diffuse sensors emit ultrasonic waves and detect the waves that bounce back off nearby objects. They do not require a separate reflector, making them useful in applications where space is limited. The distance can be measured by equation 1. Figure 3 depicts about the ultrasonic sensor.

*Distance=Time*sound speed/2 (1)*

Fig.3.Ultrasonic Sensor

D. Humidity sensor

A humidity sensor is a device that measures the amount of water vapor in the air or in a gas. Humidity sensors are important in many applications, such as weather monitoring, agriculture, and indoor climate control. There are several types of humidity sensors, but most operate by measuring changes in electrical capacitance, resistance, or temperature caused by the presence of water molecules. Capacitive humidity sensors, for example, measure the capacitance between two electrodes, which changes as the amount of water vapor in the air changes. Resistive humidity sensors, on the other hand, measure the resistance of a polymer material that absorbs water molecules.

E. GSM Module

A GSM module is a type of device that allows communication between electronic devices using the Global System for Mobile Communications (GSM) network is shown in figure 4. GSM is a standard used by mobile phone networks around the world, and the technology enables voice and data communication over the network. GSM modules are commonly used in applications such as remote monitoring, security systems, vehicle tracking, and industrial automation. They are essentially small circuit boards that contain a GSM modem, a microcontroller, and other components needed to enable communication over the GSM network. The module can be interfaced with other devices through various interfaces such as UART, SPI, or USB. It can be controlled and programmed using AT commands. These commands are used to configure the module and to send and receive data over the network. GSM modules can be used in various ways, such as sending and receiving SMS messages, making and receiving calls, and sending and receiving data. They can be used in standalone applications or integrated into larger systems.

Fig.4.GSM Module

F. LCD Display

LCD display that has 16-character positions in each of its two lines, for a total of 32-character positions is shown in figure 5. This type of display is commonly used in various electronic devices, such as digital clocks, calculators, and small embedded systems. The display consists of a liquid crystal layer sandwiched between two polarizing filters and two glass substrates. The liquid crystal layer is made up of individual cells, each of which is controlled by a transistor. By applying a voltage to the transistor, the liquid crystal molecules rotate and change the polarization of light passing through them, creating visible characters or graphics. To use a 16*2 LCD display, a microcontroller or other controlling

device is typically used to send commands and data to the display via a parallel interface. The commands and data control the display's settings, such as the cursor position, display contrast, and the characters to be displayed.

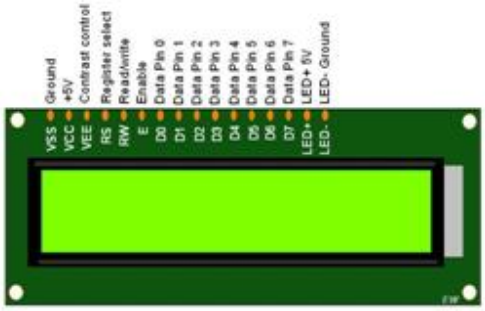

Fig.5. 16*2 LCD Display

G. Servo Motor

A servo motor is an electromechanical device that is designed to provide precise control of angular or linear position, velocity, and acceleration that depicts in figure 6. It is commonly used in applications that require accurate and controlled motion, such as industrial automation, robotics, and aerospace. The operation of a servo motor is based on feedback control. It typically consists of a rotor, a stator, and a position feedback device. The stator generates a magnetic field, which interacts with the magnetic field of the rotor to create a rotating force. The position feedback device provides information about the position of the rotor, which is used to control the motor's speed and direction. Servo motors are available in various sizes and configurations, with different levels of torque, speed, and accuracy. They can be either AC or DC powered, and can operate in both closed-loop and open-loop control systems.

Fig.6.Servo motor

H. Transformer

A step-down transformer is a type of electrical transformer that reduces the voltage of an alternating current (AC) power supply is shown in figure 7. It has more turns of wire on the secondary coil than the primary coil, resulting in a lower voltage output. To get a 12V output from a step-down transformer, you will need to know the input voltage of your power supply and the turns ratio of the transformer. The turns ratio is the ratio of the number of turns on the primary coil to the number of turns on the secondary coil. When selecting a transformer, make sure it can handle the power you need. The power rating of the transformer should be greater than the power you intend to use. Also, make sure the transformer's frequency rating matches your power supply's frequency (usually 50 or 60 Hz).

Fig.7.Transformer

II. LITERATURE REVIEW

The system monitors the garbage bins and informs about the level of garbage collected in the garbage bins through the web page. For this, the system uses ultrasonic sensors placed at the lid the bins to detect the garbage level and compare it with the garbage bin's depth. The garbage bin lifting weight can also be known by the authorities by receiving the updates in the web page.The Smart bin is built with the microcontroller-based platform Raspberry pi Uno board which is interfaced with a GSM modem and Ultrasonic sensor and also the weight Sensor which is used for calculating the weight of the dustbins. Raspberry will be programmed in such a way that when the dustbin is filled, the remaining height from the threshold height will be displayed. When the garbage reaches the limit level ultrasonic sensor will trigger the GSM modem which will persistently caution the required expert until the trash in the dustbin is dumped.This project, introduces a new method to integrate IoT green environment into automatic waste disposal and provide an efficient solution. The main function of the Smart dustbins are, to send a "DUSTBIN FULL" warning message to municipal officials. The purpose of the project is to manage waste in urban and rural areas.The project will send an SMS to municipal officials containing information about dustbin. SMS will be sent through GPS.The project uses an ultrasonic sensor to measure the level of garbage in the garbagebin and sends the data, that can be viewed through the mobile application called Blynk. It will also sents the notification to the users through email once the garbage bin capacity is full. Other than the notification function, Smart Garbage Monitoring System also consists of an automatic open and close lid, and tracks dustbin location and humidity level. The main objective of this project is to design the IoT system that detects the level of the garbage and displays the data in the Blynk app.This project,

introduces a new method to integrate IoT green environment into automatic waste disposal and provide an efficient solution.The evacuation of waste will help society to meet alarming situations like inhaling toxic gases and various health diseases. The paper discuss about the state-of-art technologies that have been .employed in literature for waste management. The proposed architecture acts as a surveillance system to monitor the overflow of garbage and delivers a message to the concerned authorities to take the necessary and immediate action.By using a sensor and GSM the environment is clean and hygienic and ensures environmental cleanliness. Improper disposal and storage of household waste create problems for public health and pollution.

III. SYSTEM WORK FLOW

The dustbin is attached to the portable hardware. The dustbin detects the level of garbage waste. If the garbage level is full, it sends an alert message to the local authorities with the GPS location. It helps the municipal truck driver to reach the location by the given GPS data. The portable hardware part and buzzer make our dustbin different from others. As the portable hardware part can be easily attached and de-attached to any type of garbage dustbin. The figure 8 depicts about the overall workflow of our proposed model.

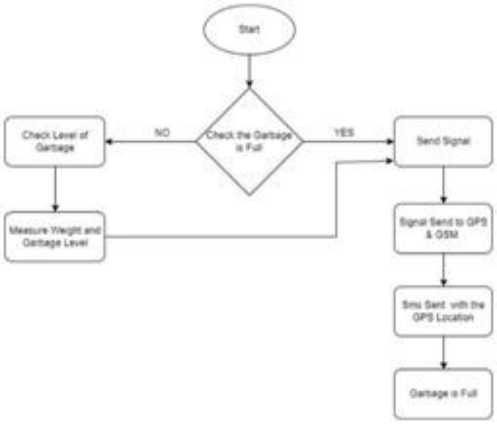

Fig. 8. Flow graph of our proposed monitoring model

The Smart Garbage Monitoring System using IOT is effective and helps the community keep their city clean the IoT garbage monitoring system consists of a microcontroller From the AVR family (Arduino Uno), and the battery of 7v and 3amp Power Supply is connected to the transformer or an Ac to Dc converter and then connected to Arduino Uno. The garbage level is sensed using the weight sensor (HX 711) and the additional sensor with an ultrasonic sensor (HC-SR04). Then the information on the level of garbage is sent to the microcontroller. The level of garbage is displayed on LCD (16x2 JHD 162A). The gained information is transferred to the concerned person through the GPRS and GSM module (SIM 8OOL)to evacuate the filled bin.

IV. PROPOSED MODEL

A hardware circuit made up of many components, which we can attach to the any size dustbin. In the visible hardware circuit, we can see the Arduino Uno R3 connected with GSM module, GPS, ultrasonic sensor and buzzer. SIM has to be inserted into the GSM module and locked. We then power up the GSM module by connecting it to Arduino's 5V and GND and then connect the Antenna of the GSM. After some time (say 1 minute) we can see the blinking ‘status LED’ or ‘network LED’ in GSM module. Once the connection is established successfully, the status/network LED will blink continuously every 3 seconds. In the GPS module, we have to connect the +5V and the ground pin, from the power side of the Arduino. The figure 9 shows about the architectural system of our model.

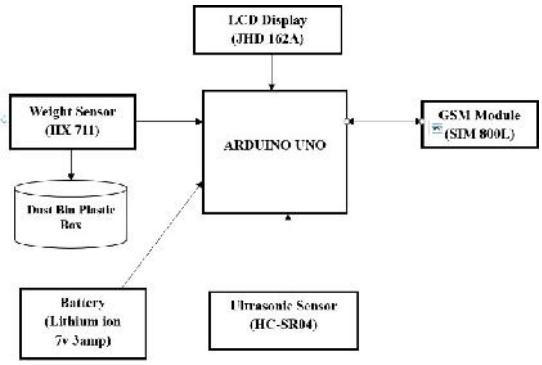

Fig.9.Architecturalsystemofourmodel

In Ultrasonic Sensor, VCC is join to 5V pin on the Arduino. The Trig pin on the ultrasonic sensor is joined to pin 10 on the Arduino. Then we connect the Echo pin on the ultrasonic sensor to pin 9 on the Arduino. And finally connect the GND to GND on the Arduino. Connect the buzzer with a PORT pin of microcontroller and the Ground of the buzzer is connected to Arduino Uno R3. Then provide Logic 1 to turn on the buzzer and Logic 0 to turn off the buzzer

V. RESULT AND ANALYSIS

The provided Integrated system of GSM module, Ultrasonic sensor is introduced for efficient and economic garbage Collection. The developed system provides improvements for garbage collection and waste amount at each location. We analysed the solution currently available for the implementation, of GIOT. By implementing this we will avoid the overflowing of garbage from the container in residential areas which is previously either loaded manually or

with the help of loaders in tradition to the Concern authority to evacuate the filled garbage trucks. It can automatically monitor the garbage level and send the information to the concerned authority to evacuate the filled garbage.The main goal of smart garbage systems is to maintain clean city surroundings and create a better living environment. we can monitor the level of garbage in dustbins. Once a particular dustbin has reached a full level, the municipal authorities can be notified and can take immediate steps to get the garbage away. The users can search for which garbage dustbins are empty, saving a lot of time. It can be used to transmit the message with the GPS location to the local authorities. The result showed in figure 10, which measures the weight's gap continues to move away from the actual weight as the weight increases.

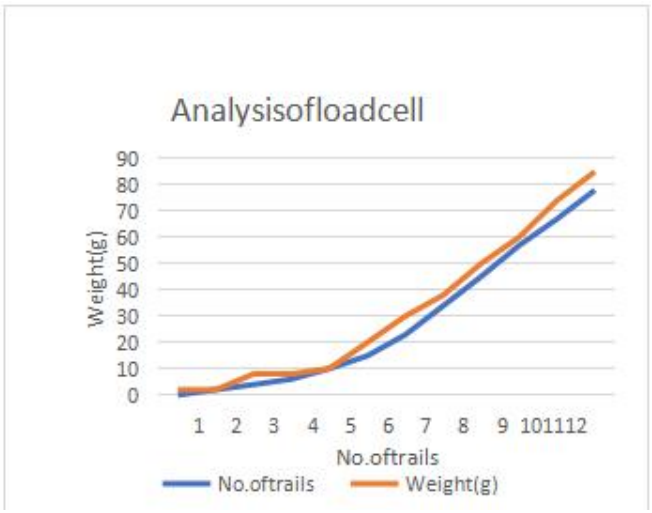

Fig. 10. Validation of Load cell based on the weight of waste collected.

VI. CONCLUSION

The outcome of our work provides a smart garbage management system, which ensures dustbins will be cleaned soon when the level of garbage reaches its maximum. If the dustbin is not cleaned in a reasonable period, the record shall submit to the higher authority which may take appropriate action against the contractor concerned. This reduces the total number of garbage collection vehicle trips and thus reduces the overall costs associated with garbage collection. Further, it also helps to preserve cleanliness in the society in an efficient manner.

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