Smart Garbage Monitoring System based on Internet of Things (IoT)

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Abstract - *A smart system can understand and sense our requirements. They have functions like sensing, actuation, and control to describe and analyze any given situation and make decisions based on the available data in a predictive manner, thereby performing smart actions. One of the many such systems is an **IOT based Smart Garbage Monitoring System**. Considering as evolved as we are, people are more likely to perform better in a well-sanitized environment. In this era of unprecedented swamping of various new diseases, one needs to have a healthy environment for the never-ending mental practices. Various missions have been initiated prominently to improve the environmental condition. It is also important to check the level of garbage-filled in a dustbin. It should neither be empty nor should be overflowing at the time of emptying it, considering the ill-effects. Therefore, we propose a system that will help to get rid of the garbage in time without any of its adverse effects taking place. IOT provides a platform for all the data received and a common language to communicate with each other. This project presents a very simple but technical approach to keep the surroundings clean. It monitors the bins and then receives data regarding the garbage level, eventually sending out it to the network where its analysis is done and respective decisions are taken.*

Key Words: Internet of Things (IOT), Arduino microcontroller, Wi-Fi modem, Ultrasonic sensors, Waste monitoring system

1. INTRODUCTION

Swachh Bharat Mission initiated by the government of India in 2019 has been recognized globally prominently to regain the environment's stability and sustainability. Our main concern should lie with the fact that our climatic conditions are changing drastically daily. Also, the Internet of things is a technology big mega-trend that will support data transfer from smart objects. Our approach will use this as a basis to design a smart system for garbage monitoring.

Today garbage handling is a big issue in developing countries. One must take up the charge for the overflowing dustbins which may lead to thriving insects and diseases in the surrounding, mismanagement of the garbage by setting it to fire, or be it the harmful elements that are taken in by various stray animals.

It is very important to check the level of garbage-filled in a dustbin. Today India ranks second globally in terms of population. As the number is increasing each day, the amount of garbage is being commensurate with it.

Cleaning the surrounding comes first before any other cleaning program. So here, we propose a system that utilizes the Internet of Things (IOT) as its basic tool. With this, we can increase the efficiency of the cleaning system that is currently employed in our nation. Overflowing garbage and emptying the garbage before it is full is our primary objective. We want to increase the system's efficiency by decreasing the energy (fuel) consumption and managing the time in which the bins are emptied.

It is also important to understand the mega-trend, which supports our model. IOT influences our lifestyle from the way we react to the way we behave. From ACs which we can control with our smartphones to the cars or our smartwatches which now can keep us updated with our daily routines for keeping good health. IOT is a giant network with connected devices. These devices gather and share data about how they are being and the environment in which they were operated.

An IOT system is nothing but a network of connected physical objects which provides a common platform for all the devices that are interfaced say, sensors, to dump their respective data & a common language to communicate with each other. Sensors play a vital role here. Sensors are embedded in every physical device that we use today. These sensors receive and continuously emit the data about the working state of devices.

Here ultrasonic sensors are to be used to detect the garbage level. This project presents a very technical approach to keep the surroundings clean. This system monitors the bins and then receives data regarding the garbage level, eventually sending out it to the network where its analysis is done and respective decisions are taken.

The ultrasonic sensors are placed upon the inner side of the lid of bins. These work upon the same principle as RADAR technology. These detect the garbage level and if the level exceeds the standard level then send this data via webpage and then analytics work upon it. They decide whether the bin should be emptied or not and if yes then when.

2. LITERATURE REVIEW

A Smart Dustbin proposed by [3], based on IOT in which the smart bin was built on a platform using Arduino which was interfaced with a GSM modem and ultrasonic sensors. The Sensor was placed and adjusted at the inner side of the lid such that it can easily detect the level filled such as in RADAR. A threshold level was set as 10cm. A threshold level is a standardized level which when reached by the garbage, the sensors detect it and triggers the GSM modem which then alerts the authority to analyze the condition of the bin. The authority then orders to empty the dustbins manually. Unless the bin is emptied the modem keeps on alerting the authority unless it's emptied. In the end, it concluded various advantages of using this such as I's affordability as Uno board was used which commensurate with the fact that it can be implemented very easily in most of the areas. Energy conservation, maintenance, and durability of the system were also addressed while designing these bins. It directly contributed to the better hygienic conditions of the surroundings and thus a healthy environment to work in.

The researchers [4] proposed a method of collection of garbage considering in both the commercial and residential areas of the society. In this also, ultrasonic sensors are used for the level detection of the garbage-filled in the bins. These sensors after detecting the level will send the data then to the Control Room using the GSM module. Here, MATLAB also played a part. GUI was developed and it was based on the MATLAB. Two units were present in the system, *the Slave unit*, and *the Master unit*. The Slave unit was present in the bin whereas the master bin was in the control room. The sensors used will receive the data and it will transmit the data through the slave unit on the lid to the master unit in the control room. Then based on data received the authorities further take the actions.

The authors [5] suggest the method of garbage management in which a microcontroller is used. The bin was interfaced with a microcontroller which IR wireless systems with a Central Monitoring System which show the current status of garbage in that bin. The status can be seen on the mobile-based browser with the HTML webpage by using Wi-Fi. This system is not cumbersome, it has a low cost, as they only used weight-based sensors on the receiver's side, and on the sender's side, they use the Wi-Fi module. And further actions are taken based on analysis done after receiving the informative data.

In [6], the LASER is used as the main tool. A laser diode is a p-n junction diode that produces a narrow beam of light which is very intense, coherent as its nature and focused. In a LASER diode, a mirrored resonant chamber is used to reinforce the light waves so that the light-emitting device is at a single frequency and of the same phase. Here, a photo-detector is used which converts the light signals into the electrical signals, further can be amplified and processed. Dustbins, Photo Detector diode, LASER Diode, Road Side Units (RSU), and Garbage collecting Vehicle (GCV) are components of the technology here. Further routing and analysis are done with the help of the Transmission Control Panel (TCP) like in any other research paper; it is a normal controlling and analysis room. The dynamic routing of GCV compared with the static solution is much more efficient and will be much more effective when more than one dustbin fills up at the same time. The initial planned route is saved so that when the real-time data is received, the only portion of the planned path may be changed.

Various bins were placed around the city, provided with a low priced embedded device, helped in tracking the garbage level in the bins [7].

3. EXISTING SYSTEM

In the existing system, the situation that prevails is of overflowing garbage from trash bins, this, in turn, leads to the unhygienic and unhealthy environment causing various harmful diseases and unpleasant odor in the surroundings. In the current system,

although the government sends a trash-collecting vehicle, the problem arises is that it could not travel to all the places on the same day. So, for the existing, the problem can be explained through an example.

Suppose there are two places A and B, a garbage collecting vehicle goes to a place A for collecting the garbage, but unfortunately, there is less garbage or no overflowing in that place, while the place B has overflowing garbage but the vehicle travels to the place B next day, thus causing a dirty environment in area B and wastage of fuel.

So, to exterminate this problem a system is designed which will indicate the level of garbage in a bin via a webpage to the control authority/municipal corporation, and as soon as the level increases the limit, the buzzer buzzes, so that the vehicle only goes to places where garbage exceed the limit, thus saving fuel and time.

Here GSM network provides easy communication between the central server and industrial or apartment. It would eliminate the postpaid and prepaid billing system. Through which we can disconnect the supply automatically if they are not able to pay the bill till 3 months or ignore the order of the central server.

Fig 1: Current Garbage System (Overflowing vehicles and bins)

4. PROPOSED SYSTEM

The existing system has some limitations such as overflow of garbage, time-consuming, unnecessary consumption of fuel, thus being detrimental to people and creating a filthy environment. The gases released by garbage are noxious and have pungent smell leading to more diseases and an unhealthy environment. So, the proposed system talks about how to make use of the recent advancement in technology to make our place clean and tidy.

This system monitors the garbage bins and notifies about the level of garbage collected in the bins via a webpage. This system makes use of ultrasonic sensors that are positioned over the bins to detect the garbage level. Also, it has an Arduino board, LCD Screen, Wi-Fi modem for sending data, and a buzzer. The system is powered by a 12V transformer.

The Proposed system helps to maintain the cleanliness of the city by indicating the level of the garbage level on an LCD screen and through a webpage to the user monitoring it.

It mainly consists of a Micro-controller unit, Overvoltage and Overcurrent relay, and GSM Module, Energy measuring Module (EMM), and Liquid Crystal Display (LCD), an AC source and Energy Metering Devices. As shown in the figure.
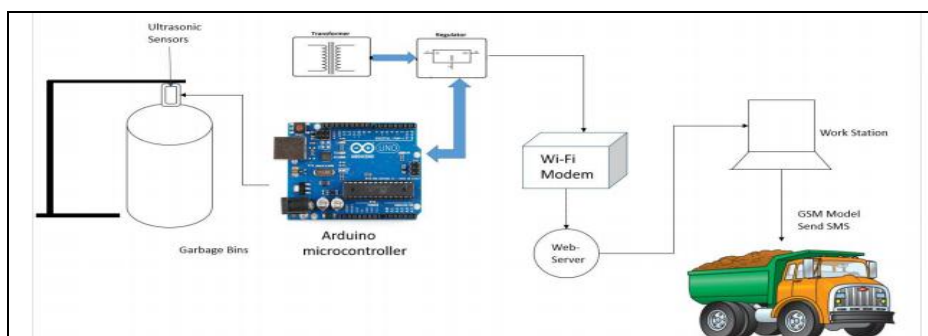
BLOCK DIAGRAM

Fig 2: Block Diagram of Smart Garbage Monitoring System

5. ADVANTAGES

- More efficient as it saves time, fuel and money
- Real-time information can be attained
- Cost-effective
- Helps to maintain a clean and disease-free environment
- Resource optimization

6. HARDWARE USED

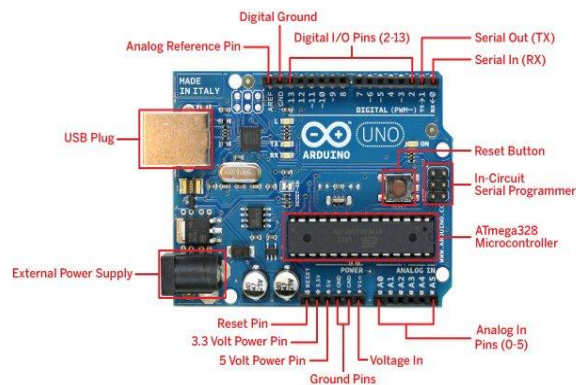- **Arduino Board:** The board consists of the components as shown in figure 4.

Fig 3: Arduino Board Components

- **Ultrasonic sensors:**
  Using the Ultrasonic sensor, distance can be computed with high accuracy and exactness. Distance of 2 cm to 400 cm can be measured using these sensors. It radiates an ultrasound wave at the frequency of 40 kHz and if any objects come in its way the wave bounces back to the sensor. By, calculating the time that it takes to strike the object and bounce back, it can be used to measure the distance.

Distance= (Time*Sound speed)/2

Where, time = time when the ultrasonic wave is transmitted and received

Ultrasonic Sensor has four pins, two of them are VCC and GND which can be connected to 5V and the GND, while the other two pins are Trig and Echo pins which can be connected to any digital pins of Arduino.

Fig 4: Ultrasonic sensor

- **Wi-Fi Module**

ESP8266 is a Wi-Fi module; it can be used to gain access to Wi-Fi or the internet. Though it is an economical device, it can empower the project more efficiently. It can be used to communicate with any type of microcontroller, thus making the project wireless.

Fig 5: Wi-Fi Module

7. FUTURE SCOPE

The project can be implemented in the 'SMART CITY' project of the Ministry of Housing and Urban Affairs, Government of India. Also, this project is helpful in 'Swachh Bharat Mission' - Gramin, Department of Drinking Water and Sanitation, Ministry of Jal Shakti.

8. CONCLUSION

An efficient garbage monitoring system that uses recent technology has been designed, to contribute to keeping the city clean by eradicating the problems related to garbage overflow, infested environment, wastage of fuel.

By implementing this system, the level of garbage can be checked using a Wi-Fi modem via a Webpage, thus an immediate action should be taken to empty the Dustbin. This proposed system is useful in both large and small scale, as it prevents manual work, also quick and prompt decisions can be made by the information provided on the webpage. In the future, some more sensors of different types can be used in the system to make it more structured, labor-saving, and effective and get precise outputs.

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