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Research paper

Smart Dumpster Monitoring System

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Abstract

The project is about smart way of collecting and disposing garbage. A system is designed by automatic opening and closing of the lid when the sensor senses the hand motion. The level of the wastes is measured using sonar sensor and the smell from the waste is detected using gas sensor. In order to avoid the smell, sprayer is placed inside the dustbin which is activated when the signal is sent. There is a motor attached to the lid is used to compress the garbage for further dumping. Once the bin is fully filled the lid is closed automatically and a message is send through GSM. The status of the bin will be displayed as a message outside the bin using LCD display. The problem of overflowing of garbage and the smell will be avoided leading to a good hygienic environment.

Keywords: *Smart Devices; Waste Management; Arduino Microcontroller; Gas Sensor; PIR Sensor; SONAR*

1. Introduction

Garbage overflow is one of the major concerns in today's world, mainly because it is accumulating at unprecedented rates. There are illustrations of overflowing garbage bins, improper maintenance and bad odors all over the country. This is harmful as it gives rise to numerous diseases due to the large number of insects and mosquitoes breeding on it. Solid waste management is one of the most difficult tasks in urban maintenance and development. Hence, the smart dustbin monitoring system can help in reducing this complication to a minimum extent. Mr. Narendra Modi, the current Indian Prime Minister, had introduced the CLEAN INDIA mission to ensure cleanliness in the surroundings.

A plethora of infections arise in a dirty and polluted environment due to various viruses, bacteria and animals scurrying around the garbage. Recent trends in technology are required to safeguard the society. This pollution is mainly due to improper garbage control. The clean atmosphere can be achieved by use of smart technologies.

In a survey conducted by the United Nations, the population increase would be 20% between the present years to 2025 and reach 8 billion. This increases the responsibilities towards solid waste management. Corruption is very common in every field, including waste administration frameworks and the economy. Thus, it is important to set an example of how to manage waste efficiently at the global level with proper governance.

As the years pass by, the population of our country increases, so that responsibility towards maintaining the environment also increases. This paper aims at providing a clean and green environment. Today, dustbin is a basic requirement everywhere. Studies conclude that garbage gets collected in areas where its removal is irregular. The model proposed includes a new prototype for a municipal dustbin which encourages the municipality to squash dustbins at regular intervals.

2. Existing System

The existing dustbin monitoring system represents the indication of the level of the garbage using ultrasonic sensor and Arduino controller which is operated by Local Area Network(LAN).The Arduino controller reads the levels of the dustbin and the status is sent to the place where the wastes are being collected. Arduino Ethernet shield is to convey the data to the LAN server in order to monitor the dustbin level.

Though Arduino has the advantages of easy usage and functionality, it also has the disadvantage. The disadvantage is that for bulk product design, the cost is higher. The system proposed consists of only pressure sensor to sense the bin which can be used only for dry waste. Different types of sensor like methane and wet sensor are to be used to sense different types of wastes like rotten and wet ingredients.

The proposed system has only admin module that can be logged in and monitor the bin. The users can also be made to register, login and get some credentials as a part of control.

3. Proposed System

Instead of using plenty of bins in an unordered fashion around the city, minimal number of smart bins can be used. Using only one sensor at the surface level instead of three not only makes it affordable but also achieves the same result.

This system monitors the garbage bins and informs about the level of garbage collected in the garbage bins. For this the system uses ultrasonic sensors placed over the bins to detect the garbage level and compare it with the garbage bins depth.

The system makes use of microcontroller, LCD screen, GSM modem for sending data and a buzzer. The system is powered by a 12V transformer. The LCD screen is used to display the status of the level of garbage collected in the bins.

The LCD screen shows the status of the garbage level. The system puts on the buzzer when the level of garbage collected crosses the set limit. Thus this system helps to keep the city clean by informing about the garbage levels of the bins.
The advantages are monitoring the garbage bins and informs about the level of garbage collected in the garbage bins. To keep our Environment clean & green. The cost & effort are less in this system.
Placing three ultrasonic sensors at three different levels of the container may be a disadvantage as the cost of the dustbin increases due to the sensors and also the sensors can be damaged due to the rough action by the users.
The system uses user friendly mobile application No. one else other than concerned authority will have access to the mobile application. The status of the dustbins can be identified in the application. Sensors are safeguarded by informing the concerned authority in case if it is damaged.

Fig 3.1: Proposed system model

4. Components

GSM Modem: A GSM modem is a specialized type wireless modem that works with a GSM wireless network. It accepts a SIM card, and operates over a subscription to a mobile operator, just like a mobile phone. A GSM modem can be an external device or a PC Card / PCMCIA Card. 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 message. GSM Modem sends and receives data through radio waves.

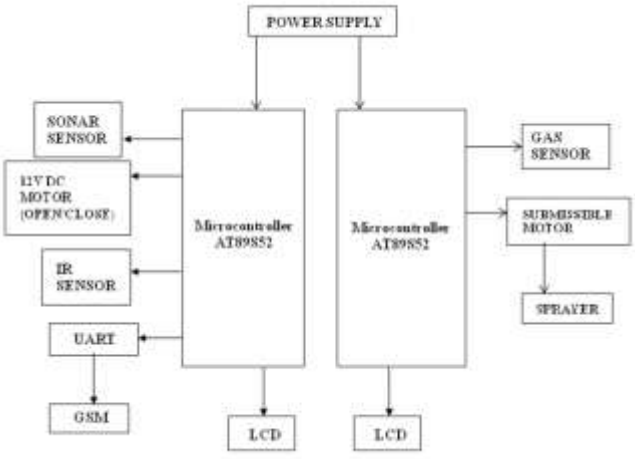

Fig 4.1: Block Diagram of Smart Dumpster Monitoring System

AT89S52 Microcontroller: The AT89S52 is a low-power, high-performance CMOS 8-bit microcontroller with 8K bytes of in-system programmable Flash memory. The AT89S52 provides the following standard features: 8K bytes of Flash, 256 bytes of RAM, 32 I/O lines, Watchdog timer, two data pointers, three 16-bit timer/counters, a six-vector two-level interrupt architecture, a full duplex serial port, on-chip oscillator, and clock circuitry. In addition, the AT89S52 is designed with static logic for operation down to zero frequency and supports two software selectable power saving modes.

PIR Sensor: The term PIR sensor stands for passive infrared sensor. It detects up 6meter with the horizontal range of 108.6 degree. When a human body or any animal passes by, then it intersects first slot of the PIR sensor.

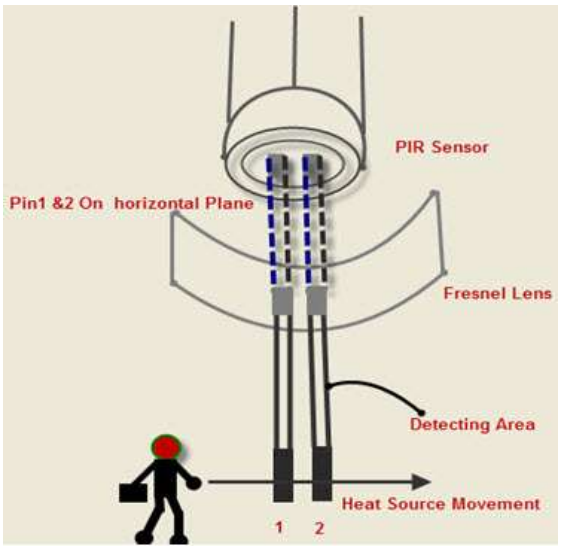

Fig 1.2: Construction of PIR sensor

This causes a positive differential change between two bisects. The infrared sensor generate a negative differential change between two bisects when a human body leaves a sensing area. The sensor is sealed hermetically to improve humidity, temperature, noise, immunity.

Gas Sensor: It is used to detect gases like H2, LPG, CH4, CO, Alcohol, Smoke and Propane. It is stable & has long lifetime possession, fast response and high sensitivity.

Sonar Sensor: Sonar sensor is used to find the level of garbage in the Trashcan. This sensor transmits the ultrasonic pulses & detects level in the form the height and receives that signal.

5. Implementation

The system is used to monitor the garbage bins. Here AT89S52 microcontroller is used and all other parts are interfaced with the ports of the microcontroller. It consists of 4 ports with 8 I/O lines. A Step down transformer is used to convert the incoming 230v AC to 12v DC and the system is powered using a power supply.
There is a GSM/GPRS modem with UART communication that can be easily connected to the other devices. A Sonar sensor which transmits and receives the ultrasonic waves that is used to find the level of garbage in the form the height. Interfacing is done between GSM modem and microcontroller to transmit & receive messages
If the bin is fully filled, the sonar sensor sends the message to GSM & this modem is activated to send an alert signal to the concerned authority through an SMS. As soon as an SMS alert is received, concerned authority can place orders to the workers for cleaning the filled bins. If the level of the bin exceeds the desired point, a motor is used to compress the garbage so that there will be some space for further dumping. The lid of the bin is opened & closed automatically by sensing the hand motion using the PIR sensor.

During the course of garbage accumulation, if there is any unpleasant smell, it is detected using MQ5 gas sensor. The submissible motor runs to start the sprayer for spraying the pleasant odor into the garbage. Every time the status of the bin will be displayed in a 2x16 LCD display. Thus the system helps to maintain a clean city.

6. Conclusion

Various features such as durability, prohibition against damage and maintenance issues are addressed when these smart dustbins are designed. This dustbin provides clean and hygienic environment. But since the technology is new in India, awareness should be created among the public before it is implemented on a large scale

7. Future Enhancements

The smart dustbin monitoring system helps to reduce the pollution. Many times, it has been noticed that the garbage is overflowing outside the bin.
Many animals like dogs, cows, monkeys and birds enter the dustbin to take garbage out of it. This may be harmful to the animals and pollute the surroundings. This scenario may be avoided in further advancements of the technology.
To enhance this project, dry waste and bio-degradable waste can be separately detected automatically without the help of man power.

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