GARBAGE MONITORING SYSTEM
FOR SMART CITIES

Lilyan Anthony[1], Pradnya Chavan[2], Astrid Ferreira[3],

Prerana Gadhave[4], Archana Shirke[5]

[1,2,3,4,5]*I.T, Fr. Conceicao Rodrigues Institute of Technology (India)*

ABSTRACT

Overflowing garbage bins have been one of the causes of concern for the people in developing countries. With increase in population, the scenario of cleanliness with respect to garbage management is degrading massively. With the already prevailing diseases, the open containers are proving to be a breeding place for germs.

The idea is newfangled as it takes care of the garbage overflow problem by generating a trigger and thus informing the authorities about the overflow of garbage so that it can be dealt with, thus helping to keep the cities clean. The objective of the system is to optimize waste collection and eventually reduce fuel consumption. Essentially, the whole concept is about collecting large amount of waste of material in least amount of time to reduce costs and emissions along the way. Hence, fossil fuel usage can be reduced as optimized routes will be undertaken for collecting garbage and thus transportation cost will also decrease substantially. Additionally, it is supposed to work with any type of container and any type of waste, including mixed materials, paper, glass, metals and fluids. This system can be used in hospitals, colleges universities, industries and various other campuses.

Keywords: Arduino Uno, Cities, Garbage Monitoring, Smart Waste Management, Ultrasonic Sensors

I. INTRODUCTION

The Internet of Things extends internet connectivity beyond traditional devices like desktop and laptop computers, smart phones and tablets to a diverse range of devices and everyday things that utilize embedded technology to communicate and interact with the external environment, all via the Internet.

Our system mainly consist of three parts: 1. Sensors

All types of sensors used for implementation of a system based on IOT are included here. 2. Communication Module

Provides interface between the communication between Hardware (Sensor) and the Application (Web-page). 3. Processing Module

Deals with data processing of the signals received from the sensors.

 In this system, the bins are connected to the internet to get the real time information of the garbage levels.

This idea of 'Garbage Monitoring System for Smart Cities will be successfully implemented with the integration of communication technologies such as Bluetooth.

The present garbage management system is not efficient enough to take care of the large amount of waste matter that is generated everyday because the garbage bins are overflowing. This causes air and water pollution. This also increases number of diseases as large number of insects and mosquitoes breed on this waste.[5] Solid waste management is a big challenge in urban areas for most of the countries throughout the world. So a waste management system that can take good care of the waste and the resulting problem of pollution is the need of the hour. Hence 'Garbage Monitoring

System for smart cities' is proposed to take care of the garbage.

In this paper, a model has been proposed in which the collection of garbage is made real time. A network is established using wireless sensors with each dustbin attached to a sensor circuitry. The sensor is placed in the garbage bin, set at a particular level. If that level is crossed by the garbage in the bin, the sensor will send a signal to the nearest vehicle driver along with the authorities in charge. Each block of the system architecture is explained in detail and the process is elaborated with a flow chart.

1.1 Hardware Description

1.1.1 Arduino Uno
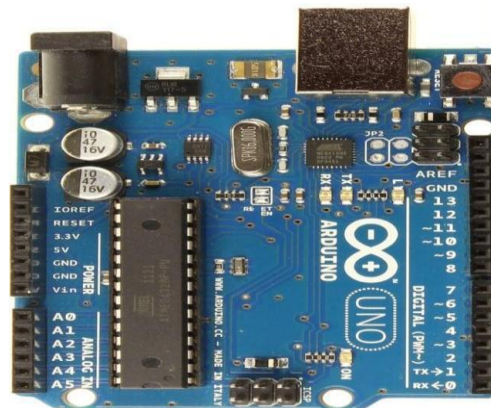
Fig.1 Arduino Uno Controller

Arduino is a computer hardware and software company, project, and user community that designs and manufactures microcontroller kits for building digital devices and interactive objects that can sense and control objects in the physical world. [8]

Following is the technical specification of Arduino

Arduino	ATmega328P
Operating Voltage	5V
Input Voltage (recommended)	7-12V
Input Voltage (limit)	6-20V
Digital I/O Pins	14 (of which 6 provide PWM output)
PWM Digital I/O Pins	6
Analog Input Pins	6
DC Current per I/O Pin	20 mA
DC Current for 3.3V Pin	50 mA
Flash Memory	32 KB (ATmega328P)

Table 1.1.1 Technical Specification of Arduino UNO.

1.1.2 Bluetooth

Fig.2 Bluetooth

Bluetooth is a wireless technology standard for exchanging data over short distances (using short-wavelength UHF radio waves in the ISM band from 2.4 to 2.485 GHz) from fixed and mobile devices, and building personal area networks (PANs).[9]

1.1.3 Ultrasonic Sensor

Fig.3 Ultrasonic Sensor

Ultrasonic sensors are divided into three broad categories: transmitters, receivers, and transceivers. Transmitters convert electrical signals into ultrasound, receivers convert ultrasound into electrical signals, and transceivers can both transmit and receive ultrasound. [10]

II. RELATED WORK

In [1], the ZigBee, GSM (Global System for Mobile Communication) and ARM7 are used to form the Integrated system to monitor the waste bins remotely. The sensors are placed in the common garbage bins placed at the public places. When the garbage reaches the level of the sensor, then that indication will be given to ARM 7 Controller. The controller will give an indication to the driver of garbage collection truck as to which garbage bin is completely filled and needs urgent attention. ARM 7 will give the indication by sending SMS using GSM technology.

In [2], they came to a point It is important to understand the societal concerns over the increased rate of resource consumption and waste production and consequently the policy makers have encouraged recycling and reuse strategies to reduce the demand for raw materials and to decrease the quantity of waste going to landfill.

In [3], it is being proposed in this paper that introduction of an integrated system combined with an integrated system of Radio Frequency Identification, Global Position System, General Packet Radio Service, Geographic Information System and web camera will solve the problem of solid waste They also analyzed the actual performance of the system.

III. EXISTING SYSTEM

3.1 ECUBE Labs

Clean CUBE- a smart solar-powered trash compactor bin that compresses garbage so that it can hold up to 8 times more than standard trash bins. [4]

Clean CAP- a smart ultrasonic fill-level sensor that can be easily installed on any type of container. It uses robust ultrasonic technology, allowing it to monitor any type of substance.

2.2 Smart Waste Management

An embedded system and network that will facilitate and speed up communication. Displays real-time information on the fill-level of the containers in order to react immediately.

2.3 Eco Bin

Eco Bin composter is a one-stop solution for all your kitchen waste, green waste, food waste, vegetarian, non-vegetarian, dairy products, citrus fruits, bread or cake, and so on. Eco Bin recycles all this waste into a nutrient rich organic compost, which also acts as a "soil conditioner".

IV. SYSTEM DESIGN

4.1 Architectural Block Diagram

This system consists of sensors, microcontroller, GSM module, Bluetooth. The detailed design is explained below.
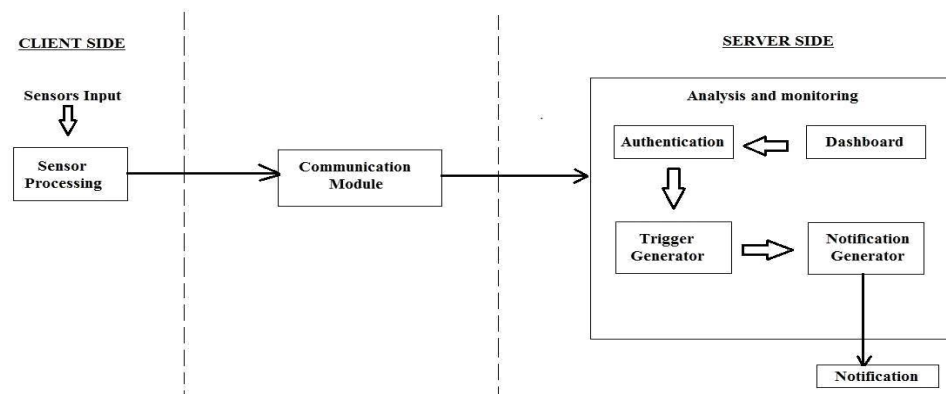
Fig.4 Architectural Diagram

The system consists of 3 major modules:

1. Sensor Module

The ultrasonic sensor is connected to the Arduino board. The sensors are used to sense the garbage levels once they are placed in the garbage bins.

2. Communication Module

The data collected by the sensors is communicated via Bluetooth which is also connected to the Arduino Uno board.

3. Analysis and Monitoring Module

The data that is collected is sent to the admin for analysis and is monitored by the admin through the web application.

The sensor input is given to sensor monitoring module, then to the communication module. Based on the information that is communicated, analysis and monitoring are done. The sensor input is processed in the sensor monitoring module. This data is transferred to the communication module through Bluetooth.

The Bluetooth receiver will then receive the information and give it to the webpage. Based on the levels of garbage in the bins which are displayed on the web page, notification will be generated. The GSM module will then transmit the message to the garbage vehicle driver.

The Admin will login to the webpage and the dashboard will open. He will be authenticated to the system. The webpage will show the status of the bins. Based on the requirements analysis and monitoring will be done. If the bins are full trigger will be generated. The SMS also gets generated, which will be sent to the vehicle driver. Thus the driver will collect the overflowing garbage. [6]
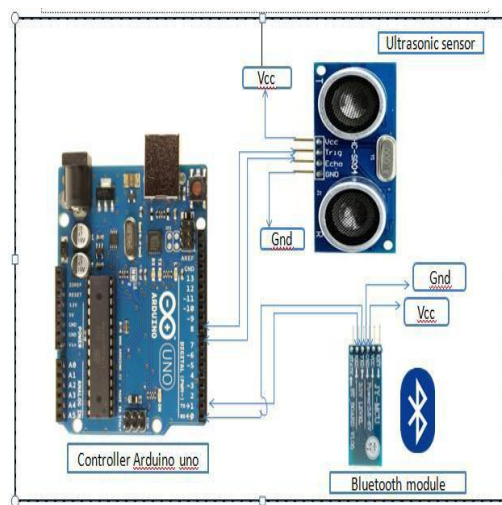
4.2 Circuit Diagram

Fig.5 Circuit Diagram

The echo pin of the ultrasonic sensor is connected to pin 7 of the Arduino and the trigger pin of the ultrasonic sensor is connected to pin 8 of Arduino. The transmitter of Arduino is connected to the receiver of Bluetooth and the receiver of Arduino is connected to the transmitter of Bluetooth, in order to establish serial communication.
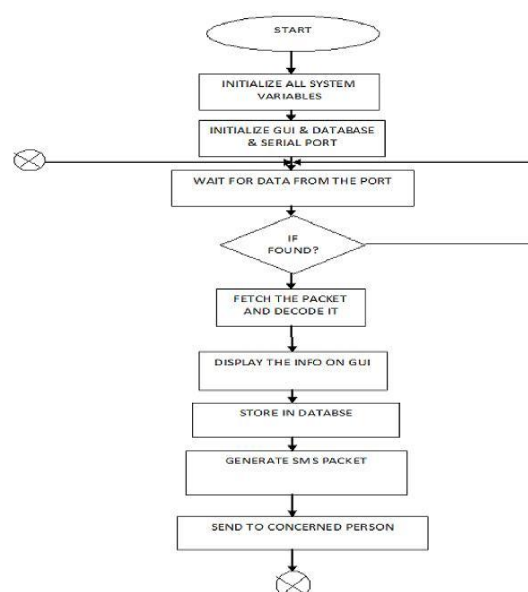
4.3 Flowchart

Fig.6 System Flowchart

In the case of a high signal from the sensor, we consider the garbage is empty. When the rays are cut, it gives a low signal, and if it persists for 10 seconds, the garbage is full and the message is sent to the concerned authorities. If the low signal persists for less than 10 seconds, the interrupt is considered to be an error and is discarded. The dustbin full signal reaches the microcontroller and a notification is generated. The dustbin full message indicating the corresponding bin is then sent to the Communication module which is then forwarded to the authorized user. The message can be passed on to N number of users and the time for a signal to persist can also be varied. The mobile number of the permanent users is included in the code burned into the microcontroller chip.[7]

V. ALGORITHMS

5.1. K-NN Algorithm:-

To track which driver is nearest to overflowing Garbage bin we use K-NN (K-Nearest Neighbour) Algorithm

K-NN is a non-parametric method used for classification and regression.

Algorithm:-

1. Determine parameter K=number of nearest neighbors.

2. Calculate the distance between query instance and all the training samples.

3. Sort the distance and determine nearest neighbors based on K-th minimum distance.

4. Gather the category of the nearest neighbors.

5. Use the simple majority of the category of nearest neighbors as the prediction value of the query instance.

VI. ADVANTAGES

□ Automatic garbage level detection prevents overflow.

● It also aids in the effective management of waste. Once installed, the maintenance cost of the system is low.

● Deployment of dustbin based on the actual needs.

● In addition, there is also the provision to alter the receptors of the message, when required.

VII. DISADVANTAGES

□ To prevent any sort of tampering of the system by the public when kept in the open.

● Disposed large-sized waste objects may obstruct the signals resulting in error messages.

VIII. APPLICATIONS

□ To collect garbage from public places in a city.

□ This project can also be used in college/university campus to maintain cleanliness.

□ In NMMC, KDMC, BMC authorities to monitor Garbage levels.

IX.. CONCLUSION

It is an automatic dustbin monitoring system in order to detect the full condition of the garbage bins. This provides the authorized users timely updates of the status of the garbage bins and thus eliminates the need for periodic manual checks and overflowing garbage bins. This paper also provides an additional feature to add new message receivers or alter the existing authorized users. It also aims at a classification of different waste and thus promoting waste management. Also, the WiMAX technology can be used instead of Bluetooth to cover large areas, but for cost effectiveness, we are implementing this system using Bluetooth.

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