

Enhanced Smart Waste Segregation and Management using Arduino

Shruthi B Gowda

Dept. of Computer science and
Engineering
Vivekananda institute of technology
Bangalore

Balapriya F

Dept. of Computer science and
Engineering
Vivekananda institute of technology
Bangalore

Chaya K R

Dept. of Computer science and
Engineering
Vivekananda institute of technology
Bangalore

Harshitha K Yadav

Dept. of Computer science and
Engineering
Vivekananda institute of technology
Bangalore

Vinutha H

Dept. of Computer science and
Engineering
Vivekananda institute of technology
Bangalore

Abstract—The rise in population, has led to tremendous decaying in the state of affairs of hygiene with respect to monitoring and management of the waste. Segregating of waste at the dumping ground is burdensome and usually ineffective. Current waste management trends are not sophisticated enough to achieve a robust and efficient waste management mechanism. The dustbins gets flooded in advance prior the initiation of the next cleaning procedure, which in turn leads to various problems such as bad smell and inelegance to the place which becomes min cause for spreading various diseses To conquer the obstacle, on-spot automatic waste segregation unit is implemented which segregates the waste into dry, wet, pper and plastic waste with automatic opening of lid.. An enhanced waste management system for the smart cities in public places, which allows segregation of waste and municipal corporation to monitor the state or level of dustbins and an alert system for garbage clearance will be sent to the municipal corporation remotely over web server when the bin gets full, which intact to keep cities clean very efficiently by reducing the time consumption required for it.

Keywords—Arduino UNO, Laser LDR sensor, Moisture sensor

I. INTRODUCTION

Waste management needs immediate attention in India. Around the world, some million tons of waste are generated each day. The major part of it is generated in metropolitan cities. But only a small amount of it is recycled. The unplanned and uncontrolled dumping at landfills is hazardous to environment which in turn affects plant, animal and human life. Due to the lack of proper segregation methods, the waste management is becoming a major problem these days. A good management of waste should be a priority to reduce environmental pollution and to ensure the safety of public health. In several countries, waste management and awareness is an emerging concept. To make sure the sound environment and sustainable development, appropriate management of waste is a must. Nevertheless, in several countries, due to lack of infrastructure and unsustainable practices have made waste management worst, which leads to environmental contamination. The present waste management practices in India are highly inadequate and inefficient. The

open-dumping and picking of waste within open dumpsites lead to severe health risks like skin infections and chronic diseases. In slum areas, the condition gets worst because of the high density of the population. It is a clear indication/hint that environmental / health issues and poor waste management are interrelated.

The raise in population, urbanization, and industrialization increases the waste generation level throughout the world. More than 64% of the population in the emerging countries and more than 84% in the developed ones will be in urban areas by 2050. Hence waste management is a global issue in terms of various environmental and public impacts. The world generates 2.01 billion tons of municipal solid waste yearly, with at least 33 percent that - extremely conservative - not managed in an environmentally safe manner. The World wide waste is expected to grow to 3.40 billion tons by 2050. Worldwide, waste generated per person per day averages 0.74 kilo but ranges widely, from 0.11 to 4.54 kilograms. The total amount of waste generated in low income countries is predicted to increase by more than three times by 2050.

Due to lack of proper segregation, we have implemented an automatic waste segregator (AWS) system for segregating the waste automatically. It will be always more beneficial, if we segregate the waste at the source level itself, thereby we can recycle and reuse the waste effectively. This can reduce the work done by the municipality. Here a waste management system is introduced in which each dumpster is fixed with a monitoring system that will notify the corresponding personal if the dumpster is full and it is also possible to separate wet ,dry, plastic and paper waste into separate containers.

II. LITERATURE SURVEY

- The proposed smart waste-bin system can be adapted into general waste-bin and it consists of the sensing units, a blue-tooth and GSM Module for data transmission, and a mobile application and web-based monitoring for interfacing and communication with the waste department for waste management. The smart bin is composed of sensor node mounted on it for the data collection and transmission. The

sensors are divided into two path. One path is mounted with the bin cover and the other is in the bottom of the bin. The first path is level sensor to monitoring the level of waste-bin. The other path is smart load cell sensor to calculate the weight of waste [1].

- An "IOT based smart garbage alert system using arduino UNO" has been proposed in which a smart alert system for garbage clearance by giving an alert signal to the municipal web server for instant cleaning of dustbin with proper verification based on level of garbage filling. This process is aided by the ultrasonic sensor which is interfaced with Arduino UNO to check the level of garbage filled in the dustbin and sends the alert to the municipal web server once if garbage is filled. After cleaning the dustbin, the driver confirms the task of emptying the garbage with the aid of RFID Tag. RFID is a computing technology that is used for verification process and in addition, it also enhances the smart garbage alert system by providing automatic identification of garbage filled in the dustbin and sends the status of clean-up to the server affirming that the work is done. The whole process is upheld by an embedded module integrated with RFID and IOT Facilitation[2].
- An IOT based smart waste clean management system which checks the waste level over the dustbins by using Sensor systems. Once it is detected, immediately this system is altered to concern authorized through GSM/GPRS. For this system Microcontroller is used as an interface between the sensor system and GSM/GPRS system. To monitor and integrate, an android application is developed for the desired information which is related to the various level of waste in different locations. The level of waste in the dustbins is detected with the help of Ultrasonic sensor. Force sensor is used to measure the weight of the dust bin. When the measured value of sensors exceeds a certain threshold value then red LED becomes ON (i.e.it indicates dustbin is filled else green led is ON) this information with GPS location where the dust bin is located is communicated to android device through GSM system. Android device will detect, in which area dustbin is located, by comparing coordinates and updates the location and inform the respective vehicle to collect the waste[3].
- In the proposed system, the robotic arm detects its path with the help of an IR sensor. The micro controller also controls the robotic arm mechanism. The bin moves with the help of DC motor when the obstacle is detected by using IR sensor which also helps in detecting the path. Micro-controller will help in moving the robot to the place where waste is sensed using IR sensor which will later undergo segregation using sensors[4].
- An IOT based automatic waste segregator system which detects and segregates the waste as dry, wet, and metallic waste at the household level and also aids in real-time monitoring of garbage level in dustbins is proposed. The system detects the arrival of debris using an ultrasonic sensor and after that checks for any metal content in the waste by using the metallic sensor. Furthermore, the trash is separated as the dry and the wet residue with the use of the capacitive detector. Once the trash is detected and separated, the wipers help to move the trash over the respective bins, and then the platform flips. Additionally, the system displays the garbage

level of the dustbins on the LCD screen as well as sends a message to clean it if it's full by the use of GSM and Arduino[5].

- An automatic waste segregator and management system is implemented where it uses a microcontroller to control the whole circuit. Wastes are placed on the conveyor belt which is made to run on the wheels powered by DC Motor. Proximity Sensor is used to distinguish Ferrite waste from non-metallic waste. Based on the readings calculated from the sensor, the suitable dustbin is selected, which is placed on the Servo motor. The dust-bin is an integration of 2 compartments which are placed accordingly which sequentially separates the waste. The first compartment is used for separating the magnetic wastes like nails, iron waste, etc. The second compartment holds the remaining things. Servo motor is used. Metal detection is done using proximity sensor. Whenever an object comes to conveyor belt; it is made to run, on the wheels powered by DC Motor. Based on the readings calculated from the proximity sensor, the suitable dustbin is selected and segregated[6].
- A cost effective Automated Waste Segregator system for the segregation of waste at the household level is implemented. The proposed segregator system segregates the waste into three types metallic, wet and dry, and in addition, separating dry waste further into paper and plastic. Here, Arduino Uno board is used as the main controller and various sensors are used to detect each type of waste, which is segregated and thrown into the respective bins. Using this automatic waste segregator system, the separated wastes can be sent directly for recycling. The system is implemented using the LPC2148 microcontroller and a LCD display is used to indicate the status of the bin. Waste is put on a conveyor belt, which is moved with the help of DC servomotor[7].
- Smart garbage segregator using IOT is implemented in which solid waste is divided into three categories Wet, Dry and hazardous waste. According to solid waste management rule, 2016 it is responsibility of generators to segregate waste into these three categories. The main objective of this project is to design a system using Arduino Mega for automatic segregating of waste at source and capable of cleaning. IR sensor estimates the distance and the status of the bin will be sent through IFTTT (If this then that) for sending SMS. This bin can be used at places like offices, apartments, shopping malls etc. This system will be useful in making Waste Management in smart cities automated without the human intervention[8].

III. PROPOSED SYSTEM

The system consists of an identification system, an automated lid system, a display system, a communication system, Esp8266 Wifi Module, a buzzer, a moisture sensor, and a laser LDR sensor. All these are synchronized using the Arduino Uno microcontroller and are described below.

Identification System Ultrasonic sensors are quite good at measuring amplitude, as the reflection of the sound wave does not depend on the objects shape. That is the main reason this sensor is preferred for the identification of personnel as well as waste level measurement. This sensor measures distance of the object from 2 cm to 400 cm within the angle of 15 degrees using an ultrasonic sound transmitter and receiver at room temperature. This sensor uses a single

transceiver unit that is capable of transmitting and receiving ultrasonic sound. The sonic pulse generated is beyond the human ear listening range, and the sonic sound waves are reflected on the most solid objects. The transceiver determines the total time required to hit an object and to return to the unit using a timer. Two ultrasonic sensors (HC-SR04) are used for the identification process. One ultrasonic sensor placed on the front side of the garbage bin helps to detect personnel within a certain. The other one placed inside the bin helps to determine the waste level of the smart bin.

Automated Lid System

Servo-motor provides an automated system for the lid of the garbage bin. It is a rotary or linear actuator that can maintain an angular or linear position perfectly. It ranges up to 90 degrees in each direction (clockwise and anti-clockwise). Servo motor (SG90) is placed in such a way so that it can make the lid of garbage bin automated. If there are any personnel detected within the range, the lid will open automatically and will remain open till the personnel is within the detection range. If the garbage bin is filled up, the lid will not open though there is personnel detected within the detection range.

Display System

LCD (16x2) is used as a display system. It is an output module which can print 32 characters at once. There is an ultrasonic sensor set up inside the bin that monitors the garbage level continuously, and the percentage filled up is displayed on LCD.

Micro-controller System

Micro-controller System Arduino board is used for the automation of the whole system. Arduino board provides a simple prototype of a microcontroller. It controls the whole system, the interactions, and the synchronization of the sensors. It reduces energy loss through sensors and servo motor by allowing voltage to flow through them only when needed. It also does has authority to GSM module used in communication system. Arduino board consists of 8 bit Atmel AVR microcontrollers with complementary components including 16 MHz crystal oscillator that may be variants with a ceramic resonator and 5V linear regulator to facilitate programming and incorporation into other circuits. A program is installed in the Arduino board to control the whole system in an automated way.

Communication System

GSM SIM800L module is used for the communication system. All the information related to the garbage level of bin is passed on using this GSM module. This chip permits us to build a 2G network for a device or computing system. The phone calls and text messaging can be done with the help of GSM sim. If the bin is filled up, then the bin addresses message to the related authority to collect the waste.

SIM800L is a quad-band module that works on frequencies GSM 850MHz, EGSM 900MHz, DCS 1800 MHz, and PCS 1900MHz with features GPRS multi-slot class 12 / class 10(optional). It supports the GPRS Coding Schemes CS-1, CS-2, CS-3, and CS-4, providing different levels of error detection and correction based on the requirements for the data being sent and the radio frequency signal conditions. It has 88 LGA pads, an IP architecture, and provides all the hardware to interface between customers' boards and the

module. Based on the data need to be transmitted, and many other factors, GSM/GPRS technology was taken into consideration. Besides the license, the cost is low for the 2G network, and there is no need for investments with infrastructure.

ESP8266 WiFi Module

The ESP8266 WiFi module is a complete WiFi network where you can easily connect as a serving WiFi adaptor, wireless internet access interface to any microcontroller based design on its simple connectivity through serial communication or UART interface

Moisture Sensor

This sensor is used to detect wet materials or wastes containing moisture elements. It is given with a 5V supply. When there is a wet material on the induction plate, the led turns on and the output is low. It works with a negative logic. It is used to detect wet waste in this bin segregator.

Laser LDR Sensor

Laser Transmitter module acts as the source of light. This module emits red light and the wavelength of the laser output is 650nanometer. In the AWS system, the laser transmitter and LDR are placed opposite to each other, and LDR is attached to the analog pin of the Arduino board. If the laser beam is discontinued, the intensity of light falling on the LDR sensor decreases, the resistance of the LDR increases, thereby the analog output voltage from the LDR is decreased. If there is no interruption, the intensity of light falling on the LDR sensor increases, the resistance of the LDR sensor decreases, and the analog output voltage from the LDR is increased. The analog voltage from LDR is converted into a digital value from 0 to 1023 by the built-in ADC within the Arduino. If the output of ADC lies between 600 to 750, the waste is detected as paper, otherwise as plastic.

Buzzer

An arduino buzzer is a tiny speaker that is directly connected to Arduino board. The buzzer produces a sound whenever the dustbin is full. The sound produced by the is based on reverse of the piezoelectric effect.

IV. METHODOLOGY

An integrated Arduino program is developed to synchronize the identification system, automated lid system, micro-controller, display system, and communication system. An ultrasonic sensor is attached to the front side of the garbage bin. The transmitter of the ultrasonic sensor emits an ultrasonic sound that is beyond the human ear listening range, and the receiver receives the reflected sound waves by the solid objects. Therefore, if there are any personnel detected within a certain range, the lid will open automatically with the help of a servo motor set up in the upper portion of the garbage bin. A 30 cm range was set up for the proposed identification system. After the lid being opened, one can put garbage inside the garbage bin, and the lid will remain open until the personnel is within the detection range. Finally, if the personnel leave the detection range, the lid will close automatically. A +5V power supply is used to power the system. The electrical connection between all the components used to develop the proposed system is shown in Fig. A closed bin is presented here to avoid interference with the external factors like animals and unusual weather conditions

that can cause littering of waste. The waste level inside the waste bin is continuously monitored by an ultrasonic sensor set up inside the garbage bin. The ultrasonic sensor transmits ultrasonic sound, and the sound waves get reflected by the garbage inside the waste bin. There is a time gap between transmitting ultrasonic sound and receiving the reflected sound waves. With the help of this time gap, the percentage filled up inside the garbage bin is calculated. The calculated numeric data is displayed with the help of the LCD placed in front of the bin.



CONCLUSION

Population explosion, increasing industrialization, and rapid urbanization has lead the world's environment into complete chaos. Due to the increased level of waste generation, gradually it's getting difficult to survive in the densely populated urban areas. Traditional waste management systems are a complete failure to handle such a large amount of garbage. The application of technology and its sophisticated service in every sector have made our life quite easy. It is high time to apply a technology based approach to handle the increasing level of waste. The proposed system successfully demonstrates its capability of real time monitoring of waste and automatic segregation of waste in to dry, wet and dry is further segregated to plastic and paper. The system displays the garbage level of the dustbin on the LCD screen and sends message to the responsible authorities to pick up the waste in case the bin is full. The inlet section is incorporated with a automatic lid opener using an IR sensor. This type of system can be fabricated in larger dimension for use in various places like educational institutes, offices, hospitals, public places etc. And is more effective and reliable compared to present waste management system as it excludes the human work to segregate waste to a great extent.

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