IOT Based Smart Garbage Monitoring And Classification System

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Abstract- *At the present time, our environment is being polluted by massive deposits of global waste. As the volume of solid waste increases rapidly, waste management is becoming a big challenge to the authorities and governments handling them. The use of modern and innovative technologies will pave the way for a better monitoring and control of waste as compared with the traditional approach, which makes use of human labour, garbage bins and disposal trucks. The spill over of waste in civic areas generates the polluted condition in the neighbouring areas. For eliminating or mitigating the garbage disposal an efficient waste management system is essential. Hence this project is designed to develop an IoT based Smart Waste Clean Management System which identifies the garbage level in the dustbins by using sensors. The garbage level is monitored using camera and image processing method and to classify the types of waste. Once it is detected, the status of the waste bin and waste truck is informed immediately to the control station through IoT and proper action is taken. The system consists of sensors and Arduino UNO microcontroller which is used to interface the sensor system and IoT system. The proposed system will help to create better green and clean environment with low cost.*

Keywords- Arduino, Image processing, IOT, Sensors

I. INTRODUCTION

Population growth and rapid urbanization lead to a huge increase in waste generation, so the traditional methods of waste collection have become inefficient and costly. The most efficient way for this extraordinary amount of waste can be solved is through smart waste management with obsolete methods of waste collection. If local authorities put a bin in a high traffic area, it will fill up quickly, and start to overflow onto the walkway. By the time collectors come to empty it, the supposed public benefit has become a very unhygienic.

In smart cities where environmental pollution is supposed to be graciously reduced, sanitation measures are vital, and cleanliness begins with providing garbage bins for waste disposal at strategic locations. The real-time monitoring and control of garbage bins placed in strategic locations and disposal at the final destination is very essential. Wastes can be divided into two categories, liquid or solid waste, both can be hazardous. Both of the waste can be grouped into organic, reusable and recyclable waste. Though, the waste collection is consistent however the current collection does not allow the local municipal to know the status of the garbage bin either full or empty.

In existing method, the dustbin is not monitored continuously and also the garbage is collected by municipal people by weekly once or by 2 days once. There is no wireless technology available for monitoring the process. And also, there is no proper way in disposing the wastes. Nowadays garbage is not handled very hygienically by the people. Due to this, there will be a possibility of spreading diseases and also will be more stinky to the neighborhood. It does not have a systematic schedule to collect every type of garbage, the overloaded garbage will attract animals and insects. So, it will create unhygienic condition for surrounding.

The proposed system is developed to maintain wastes according to their nature. This project is designed to develop a smart green environment of garbage monitoring systems by measuring garbage level in real time and to separate wastes on the basis of types of wastes. This is implemented using Image Processing technique. The main objectives of the project are to design a prototype of Internet-of-Thing (IoT) based smart garbage monitoring system and alert the garbage collectors of the fullness of the bin by identifying the level of garbage based on the depth of the bin. Thus, this proposed system will create a greener environment by monitoring and controlling collection of garbage efficiently with low cost and better performance.

II. LITERATURE REVIEW

In the title [1] IoT Based Solid Waste Management System,proposed by Abhay Shankar, Bharadwaj Rainer Rego, Anirban Chowdhuryexplained that the Internet of Things (IoT) is constantly evolving and is giving unique solutions to the everyday problems faced by man. “Smart City” is one such implementation aimed at improving the lifestyle of human beings. One of the major hurdles in most cities is its solid waste management, and effective management of the solid

waste produced becomes an integral part of a smart city. This paper aims at providing an IoT based architectural solution to tackle the problems faced by the present solid waste management system. By providing a complete IoT based system, the process of tracking, collecting, and managing the solid waste can be easily automated and monitored efficiently. By taking the example of the solid waste management crisis of Bengaluru city, India, we have come up with the overall system architecture and protocol stack to give a IoT based solution to improve the reliability and efficiency of the system. By making use of sensors, we collect data from the garbage bins and send them to a gateway using LoRa technology. The data from various garbage bins are collected by the gateway and sent to the cloud over the Internet using the MQTT (Message Queue Telemetry Transport) protocol. The main advantage of the proposed system is the use of LoRa technology for data communication which enables long distance data transmission along with low power consumption as compared to Wi-Fi, Bluetooth or Zigbee.

In the title [2] IOT Based Smart Garbage alert system using Arduino UNOby Dr.N.Sathishkumar, B.Vijayalakshmi,R. Jeniferprarthana, A. Shankar said that the waste management is one of the primary problems that the world faces irrespective of the case of developed or developing country. The key issue in the waste management is that the garbage bin at public places gets overflowed well in advance before the commencement of the next cleaning process. It in turn leads to various hazards such as bad odor & ugliness to that place which may be the root cause for spread of various diseases. To avoid all such hazardous scenario and maintain public cleanliness and health this work is mounted on a smart garbage system.The main theme of this work is to develop a smart intelligent garbage alert system for a proper garbage management.The paper proposes 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 RF ID and IOT Facilitation. The real time status of how waste collection is being done could be monitored and followed up by the municipality authority with the aid of this system. In addition to this the necessary remedial / alternate measures could be adapted. An Android application is developed and linked to a web server to intimate the alerts from the microcontroller to the urban office and to perform the remote monitoring of the cleaning process, done by the workers, thereby reducing the manual process of monitoring and verification. The notifications are sent to the Android application using Wi-Fi module.

In the title [3]A Waste City Management System for Smart Cities Applications proposed by Dung D. Vu, Écolede Technologie Supérieure Montréal, George had worked and presented a new method of smart waste city management which makes the environment of the city clean with a low cost. In this approach, the sensor model detects, measures, and transmits waste volume data over the Internet. The collected data including trash bin's geolocation and the serial number is processed by using regression, classification and graph theory. Thenceforth a new method is proposed to dynamically and efficiently manage the waste collection by predicting waste status, classifying trash bin location, and monitoring the amount of waste. Then, this latter recommends the optimization of the route to manage the garbage truck efficiently. Finally, the simulation results are presented and estimated.

In the title [4]IoT based Solid Waste Management System for Smart City proposed by KrishnaNirde, Prashant S. Mulay,Uttam M.Chaskar presented that today, waste management from its inception to its disposal is one of the important challenges for the municipal corporations in all over the world. Dustbins placed across cities set at open places are flooding because of increment in the waste each day and making unhygienic condition for the citizens, to maintain a strategic distance from such a circumstance we have proposed wireless solid waste management system for smart cities which allows municipal corporations to monitor status of dustbins remotely over web server and keep cities clean very efficiently by optimizing cost and time required for it. As soon as dustbin has reached its maximum level, waste management department gets alert via SMS via GSM module placed at dustbin so department can send waste collector vehicle to respective location to collect garbage.Theobjectiveis to enhancethis project, solid waste collection bin and for smart city.

In the title[5]Cloud Computing Based Smart Garbage Monitoring System written byJetendra Joshi, Joshitha Reddy, Praneeth Reddy, Akshay Agarwal, Rahul Agarwal said that healthy environment is imperative to a healthy and happy community. With theold age system of hiring people to regularly check and empty filled dustbins, the process has

been prone to human error and neglect. Additionally, due to different frequency of usage of dustbins in different areas, routine checks which are based on time crevices is inefficient because a dustbin might get filled early and may need immediate attention or there might not be any need of a routine check for a long period of time. This makes present system resource expensive and ineffectual, as overflowing, stinking dustbins become more of a problem than a solution. In this paper we present a solution about the SmartBin is a network of dustbins which integrates the idea of IoT with Wireless Sensor Networks. We also put forward the concept of a network of smart garbage bins based on the Stack Based Front End approach of integrating Wireless Sensor Network with the Cloud computing and discuss how Machine Learning techniques like Decision Forest Regression can be applied to the sensor data leveraged by the system to gain useful insights to improve the efficiency of the garbage monitoring.

III. METHODOLOGY

Proposed methodology describes how the system must be operated and what the system should do. It gives the objectives of the project.

In this proposed system, the level of garbage ismonitored continuously using sensors. Then, the degradable and non-degradable waste which comes in it is separated by using servo motor. Image processing is used to identify and separate the different types of waste. This developed model is highly beneficial with low cost and better performance. The status of the dustbin is monitored continuously and updated to the control station using IOT.

OBJECTIVES

- To monitor the status of the garbage through the sensors continuously.
- Different types of wastes are classified
- If the garbage is full, it is updated to the control station through IOT.

BLOCK DIAGRAM

In this system, we use ARDUINO UNO microcontroller which acts as brain of the system, because the entire system program instruction stored in it. Ultrasonic sensor is used to the garbage level.

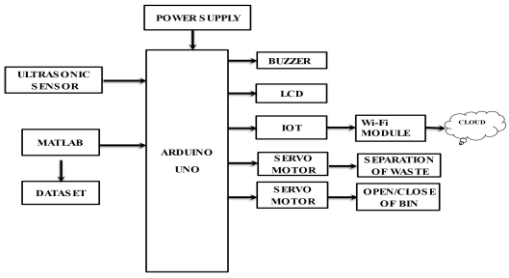

Fig. 1 Block diagram of IOT based Garbage Bin

In second section the image processing is used to identify the plastics and degradable items and then it is separated. Here all the movement is done by using servo motor. The dustbin data are uploaded to the cloud using IOT. So that all the operation is either controlled or monitored by IOT.

The details of the hardware and software required for this project are given below;

Hardware Requirements Software Requirements

Arduino UNO	Embedded C
Power supply +5V dc	Arduino software IDE
LCD	MATLAB
Servo motor	
Buzzer	
Ultrasonic sensor-HC-SR04	
IOT	

IV. HARDWAREDESCRIPTION

ARDUINO UNO

Arduino is an open-source microcontroller electronics platform based on easy-to-use hardware and software. Arduino boards are able to read inputs - light on a sensor, a finger on a button, or a Twitter message and turn it into an output - activating a motor, turning on an LED, publishing something online. Arduino is used in thousands of different projects and applications. The Arduino software is easy-to-use for beginners, yet flexible enough for advanced users. Arduino UNO has 14 digital input output pins, 6 pulse width modulation (PWM) pins and 6 Analog input pins. Arduino UNO has 5 volts and 3.3 volts pin as well. Arduino code is dumped into the Arduino board so that the messages are displayed in LCD and the process is executed according to the instruction.

POWER SUPPLY

The power supply section is the important one. It should deliver constant output regulated power supply for successful working of the project. The primary of this transformer is connected in to main supply through on and off switch& fuse for protecting from overload and short circuit protection. The secondary is connected to the diodes to convert 12VAC to 12V DC voltage. And filtered by the capacitors, which is further regulated to +5v, by using IC 7805.

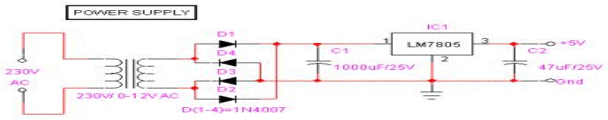

Fig.2 Circuit Diagram

LCD

LCD screen is an electronic display module which uses liquid crystal to produce a visible image and find a wide range of applications. A 16x2 LCD display is very basic module and is very commonly used in various devices and circuits. A 16x2 LCD means it can display 16 characters per line and there are 2 such lines. In this LCD each character is displayed in 5x7pixelmatrix.Here, this displays the message when garbage is filled 40%, 70%, 100% and also “GARBAGE FULL” and also it denotes the classification of waste.

Fig. 3 16X2 LCD

SERVO MOTOR

A servomotor is a rotary actuator or linear actuator that allows for precise control of angular or linear position, velocity and acceleration. It consists of a suitable motor coupled to a sensor for position feedback. It also requires a relatively sophisticated controller, often a dedicated module designed specifically for use with servomotors. A servomotor is closed-loop servomechanism that uses position feedback to control its motion and final position. In this project, servo motor is used to separate the different types of waste, also opening and closing of the bin.

Fig. 4 Servo Motor image

ULTRASONIC SENSOR

The HC-SR04 ultrasonic sensor uses sonar to determine distance to an object like bats do. It offers excellent non-contact range detection with high accuracy and stable readings in an easy-to-use package. The sensor head emits ultrasonic wave and receives the wave reflected back from the target. Ultrasonic measures the distance through the target by measuring time between emission and reception. Here the target is wastes. In this project, it detects the distance between the wastes and bin and indicates to the control station if the garbage is full. When a person comes closer to the bin, the bin will automatically open for waste disposal and then it will close automatically.

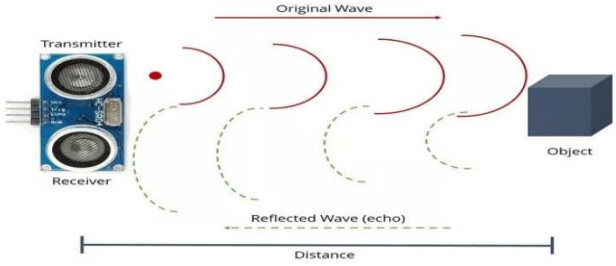

Fig.5 Ultrasonic Sensor process

BUZZER

A buzzer or beeper is an audio signaling device, which be mechanical, electromechanical or piezoelectric. Typical uses of buzzers and beepers include alarm devices, timers, etc. When the garbage is full, there will be buzzer sound to indicate that the bin is filled with wastes

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How to choose a buzzer:

There are many different kinds of buzzer to choose, it should have few parameters, such as voltage, current, drive method, dimension, mounting type, and the most important thing is SPL and frequency we want.

IOT

The Internet of Things (IoT) is the network of physical devices, vehicles, buildings and other items embedded with electronics, software, sensors, actuators and network connectivity that enable these objects to collect and exchange data. Data is updated to a specific site or a social network by which the user can able to access the data. The IoT sends the message when the garbage is filled with wastes.

Fig. 6 IOT board

FEATURES OF IOT:

•Power Supply: DC +12v 1Amp
•Auto data updating: 30sec
•Digital Output port Pins: +5V DC
•provided with 3 links

1. Data updating to a specific web site
2. Device controlling web site
3. Data updating to a social network

V. SOFTWARE DESCRIPTION

EMBEDDED C

Embedded C is most popular programming language in software field for developing electronic gadgets. Each processor used in electronic system is associated with embedded software. Embedded C programming plays a key role in performing specific function by the processor. All these devices are working based on microcontroller that are programmed by embedded C.

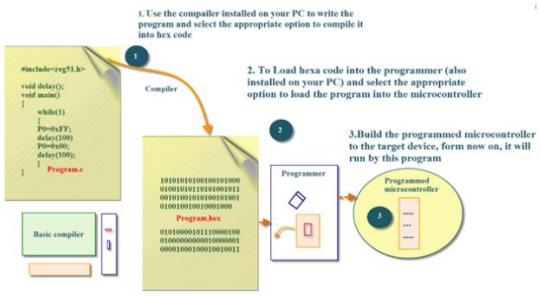

Fig.7 Embedded C format

In embedded system programming C code is preferred over other language. Due to the following reasons:

- ✓ Easy to understand
- ✓ High Reliability
- ✓ Portability
- ✓ Scalability

ARDUINO SOFTWARE IDE

The Arduino Integrated Development Environment or Arduino Software (IDE) - contains a text editor for writing code, a message area, a text console, a toolbar with buttons for common functions and a series of menus. It connects to the Arduino and Genuine hardware to upload programs and communicate with them.

Since version 1.0.1, the Arduino Software (IDE) has been translated into 30+ different languages. By default, the IDE loads in the language selected by your operating system.

MATLAB

MATLAB can help you design, prototype, and deploy IoT applications such as predictive maintenance, operations optimization, supervisory control, and more.It supports time-stamped and unstructured data from many sources including cloud storage services and databases.In this project, the datasets are stored in MATLAB to show the waste classification like cloth, metal, plastic, glass and medical wastes. MATLAB code is dumped in image processing for classifying the waste.

MONITORING SECTION:

- ♦ Monitor and separate the waste items
- ♦ Image processing

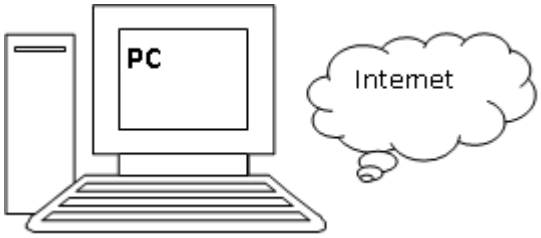

Fig.8 Monitor

1.Monitor and separate the waste items:

Ultrasonic sensor is used to measure the garbage level and servo motor is used for separating wastes.

2. Image processing:

The image processing is used to identify the wastes and degradable items and it is separated. Here all the movement is done by using servo motor. The dustbin data are uploaded to the cloud using IOT.

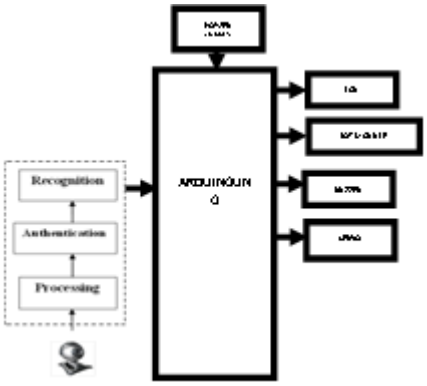

Fig.9 Block diagram of Image Processing Section

VI. VERIFICATION AND RESULTS

The hardware components and software are connected properly. After giving the power supply, the ultrasonic sensor detects the level of garbage and separates the waste from the bin using image processing and the output is given.

Fig. 10 Smart Garbage prototype

Fig.11 Smart Garbage prototype of waste classification

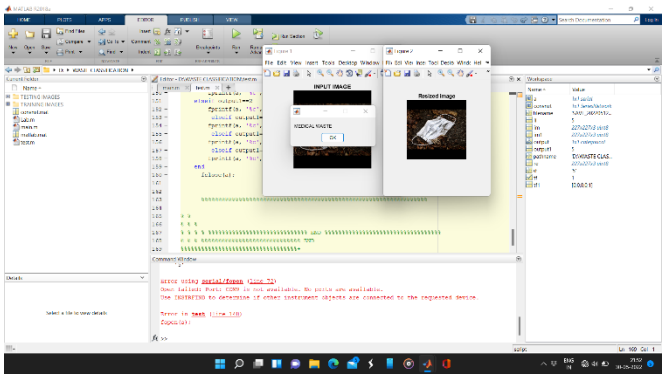

Fig.12 Simulation output of MATLAB

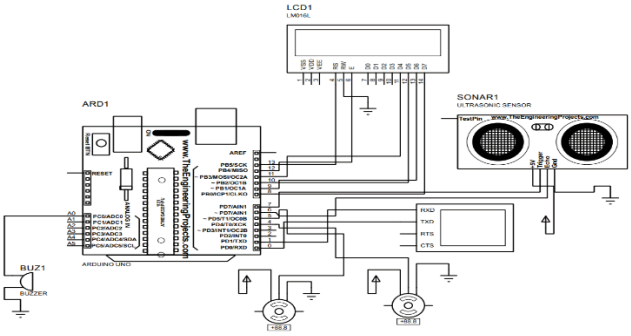

Fig.13 Circuit diagram of Smart Garbage

VII. CONCLUSION

Many smart-enabling technologies (e.g.the IoT, cloud computing, big data analytics, etc.) and management strategies (e.g. source separation, standardization, points rewards, etc.) improve the timeliness and accuracy of waste classification, collection and transportation. This project is based on image processing will show a new way for making a hygienic and green environment. Based on a new generation of information technology, it can improve the accuracy of waste classification and enhance the enthusiasm of public to participate in waste classification.

In future, the proposed system can be implemented in real time using web camera and sensor in the dustbin.

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