IOT BASED TRASH MANAGEMENT SYSTEM

SUBMITTED IN PARTIAL FULFILMENT OF THE REQUIREMENTS

K.Kalpana[1], Badugu Devrath[2], Bommakanti Rajkumar[2], Kasoju Navaratna Prasad[2], Vattikulla Giridhar[2]

[1]Assistant Professor,[2]UG Student,[1,2]Department of Electronics & Communication Engineering

[1,2]Malla Reddy Engineering College and Management Sciences,Kistapur,Medchal,501401, Telangana

ABSTRACT

This project is motivated by the urgent need for a more efficient waste management system to meet the challenges of uncollected waste in the city, especially during events such as cholera epidemics. To combat this problem, we propose a IoT-based waste collection system designed to provide real-time information on the status of waste bins, enabling quick action. The system integrates IoT capabilities to optimize waste collection routes, reduce operating costs and ensure timely collection. Notifications are sent to the appropriate staff regarding the location of full trash cans, ensuring prompt collection of trash, which prevents overflow problems. This system is implemented with ultrasonic sensors that detect the level of waste in the bin and a person approaching the bin to remove the waste. This system is controlled by an Arduino microcontroller and an IR sensor connected to a servo motor that automatically opens and closes the lid and continuously displays the status information "full", "partially full" or "empty" on the LCD screen at regular intervals, sends content level information at those intervals to a central web server system that displays container levels graphically. By utilizing advanced technology, this system aims to enhance waste management practices and promote sustainability in urban environments. The system notifies the person (Truck Driver) in charge of garbage collection by sending alert into IoT server and telling them where the full bin is exactly located. This development will ultimately save a lot of time especially when the council does not have to go and check the level of garbage in the bin. Besides, it will timely prevent the overflow of garbage due to the fact that garbage will be collected on time.

Keywords: Ultrasonic sensors, Arduino microcontroller, Internet of Things (IoT), Waste bins, LCD screen, DC motor, IR sensor, Real-time data, Waste bin status, Waste optimization, Operating costs.

INTRODUCTION

We are living in an age where tasks and systems are fusing together with the power of IoT to have a more efficient system of working and to execute jobs quickly! With all the power at our finger tips this is what we have come up with. The Internet of Things (IoT) shall be able to incorporate transparently and seamlessly a large number of different systems, while providing data for millions of people to use and capitalize. Building a general architecture for the IoT is hence a very complex task, mainly because of the extremely large variety of devices, link layer technologies, and services that may be involved in such a system. One of

the main concerns with our environment has been solid waste management which impacts the health and environment of our society. The detection, monitoring and management of wastes is one of the primary problems of the present era. The traditional way of manually monitoring the wastes in waste bins is a cumbersome process and utilizes more human effort, time and cost which can easily be avoided with our present technologies. This is our solution, a method in which waste management is automated. This is our IoT Garbage Monitoring system, an innovative way that will help to keep the cities clean and healthy. Today main issue for pollution is Garbage Overflow. It creates unhygienic condition for the people and creates bad smell around the surroundings this leads in spreading some deadly diseases & human illness. To avoid all such situations, we are going to implement a project called IoT Based waste management using smart dustbin. Implementation is done with the help of IoT concept. The Internet of Things (IoT) is a concept in which surrounding objects are connected through wired and wireless networks without user intervention. Objects communicate and exchange information. In this system multiple dustbins are located throughout the city or the Campus, these dustbins are provided with a sensor which helps in tracking the level and weight of the garbage bins and a unique ID will be provided for every dustbin in the city so that it is easy to identify which garbage bin is full. When the level and weight of the bin reaches the threshold limit, the device will transmit the reading along with the unique ID provided. In order to avoid the decaying smell around the bin harm-less chemical sprinkler is used which will sprinkle the chemical as soon as the smell sensors detect the decaying smell.

1.LITERATURE SURVEY

The idea of smart garbage bins and systems have been in discussion for quite a long time. The technologies used at disposal to develop this smart system have also evolved, Internet of Things (IoT).Each idea seems to be similar but is slightly different at its core and our proposed work is no exception from the same. After the IoT field, finding its hold in our lives, this is our original plan for designing a smart garbage collection system which has provision for citizen participation and analysis of data for better decision making [1].

At hardware level, the smart system is a garbage bin with IR sensor, a micro-controller and Wi-Fi module for transmission of data. This work exploits the future possibilities, key technologies and application that are likely to drive IoT research. But a strong foundation to our work is provided, where the basics and applications of Arduino board is explained [2].

IoT allows traditional, physical objects to communicate among each other by transforming them into “smart objects” using several essential technologies such as embedded devices, sensor networks, and Internet protocols [3].

The overall concept of IoT is depicted in Figure 1 which shows an example of domains suitable for IoT services. In a SSWMS, the smart waste bins are integrated with several sensors (e.g., proximity sensor, weight sensor, temperature sensor, etc.) [4].

These sensors then collect related real-time data regarding the solid waste inside the bin before the microcontroller embedded on each bin transfer the data to Cloud servers. Next, the Cloud servers communicate with specially developed mobile-based and/or web-based applications for monitoring and management purposes [5].

To conducted an investigation on proposed Smart City services driven by IoT by using SLR. The SLR gathered literature regarding applications of IoT in the development of Smart City services before dividing them into categories of proposed or described services [6].

Discuss environmental sustainability and smart city concept and the SLR focuses on theoretical basis concepts of both sustainability and smart city, their relationships, issues, proposed works and strength and weaknesses of related works. The aim of this system is to assist the waste management team to carry out their work more efficient in terms of (but not limited to) monitoring, scheduling and cutting operational cost [7].

There is no universal solution on how SSWMS should be planned and implemented as it is a complex task. Therefore, several factors and aspects need to be considered and analysed. IoT is an integral part of any development and implementation of SSWMS [8].

Internet-of-Things (IoT) is a group of infrastructures interconnecting linked objects and permitting their management, data mining and access to the information they generate. The interconnection between objects is realized by having an Internet connection and/or cloud server as its gateway [9].

To understand the IoT concept further, it is divided into six components as shown in Table 3: Components of IoT Component Examples IoT Identification Object ID, object's address IoT Sensing Smart actuators, sensors, wearable sensing devices IoT Communication [10].

Smart City can be defined as a future-looking and well performing city based six characteristics (i.e., Smart Economy, Smart People, Smart Living, Smart Governance, Smart Mobility and Smart Environment), built on the ability's combination and activities of independent, self-decisive and conscious citizens [11].

A SLR has been carried out to find out potential indicators in implementing Smart City. In the SLR, the author manages to list out twelve main indicators that can be used as the main factors in making the decision regarding Smart City Development which includes environmental sustainability [12].

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 [13].

Future university campuses will be characterized by a series of novel services enabled by the vision of Internet of Things, such as smart parking and smart libraries. In this paper, we propose a complete solution for a smart waste management system with the purpose of increasing the recycling rate in the campus and provide better management of the entire waste cycle [14].

For the last few years, many researchers are focusing on IoT based applications, especially smart city. A smart city is an infrastructure where everything is interconnected and can interact with each other. In a smart city, everything is supposed to be smart and intelligent in decision-making ability. A smart city leads to a smart environment, smart health, smart parking, smart economy, smart administration, and smart living of the people [15].

3. PROPOSED SYSTEM

Whenever the garbage is full information can be sent to the concerned authority to clean the bin. IoT is used in the project as a communication back bone for the whole system for various reasons like low cost, easy to implement and less signal deterioration. This project uses the ultrasonic sensor module, IoT Modem, the Arduino Microcontroller and Liquid Crystal

Display (LCD). Without a smart waste management system, any smart city is incomplete. In the proposed system, the level of waste material in the garbage bin has been detected with the help of ultrasonic sensor and it will continuously communicate to the authorized control room through IoT module. Microcontroller is used to interface the sensor system with IoT system.

Flow Diagram:

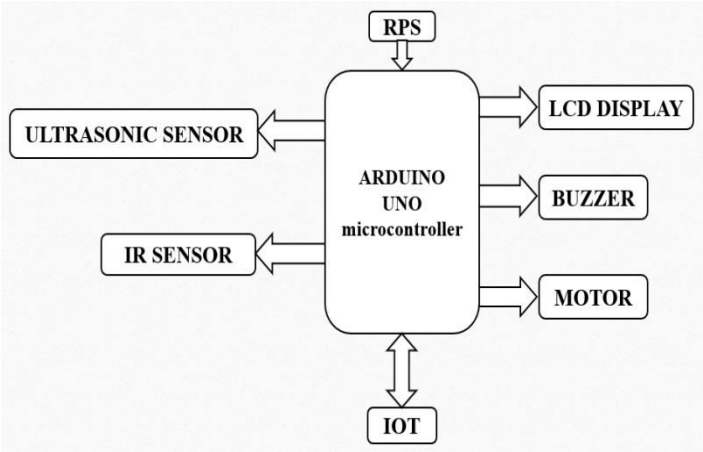

Figure :1. Block Diagram

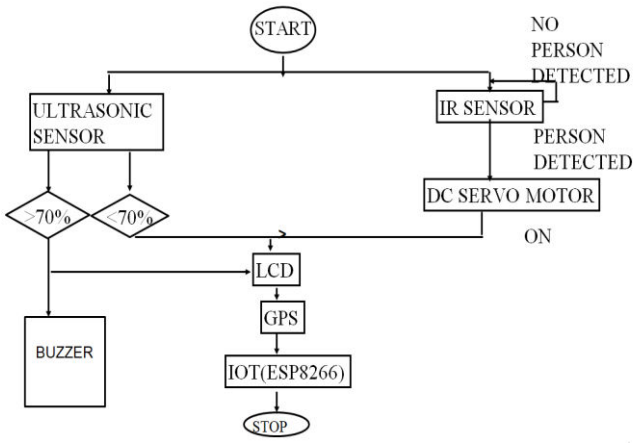

Figure :2.Flow Diagram

Working:

The code involves interacting with various hardware components like ultrasonic distance sensors, motors, LCD displays, and more. The code snippet includes functions to set up and control these components, as well as functions to communicate with a server for data storage and retrieval. Here's a brief summary of what the code does:

1. **Initialization:** The code begins with the necessary includes and the initialization of various pins and components, such as the LCD, ultrasonic distance sensor, motors, and a buzzer.

2. **Ultra Sonic Distance Measurement:** The ultra_dist() function calculates the distance from an ultrasonic sensor using the trigPin and echoPin. The duration of the echo is measured, and the distance in millimeters is calculated.
3. **Setup Phase**: In the setup() function, the code initializes the serial communication, sets up pins, displays messages on the LCD, and initializes the Wi-Fi connection.
4. **Main Loop:** The loop() function contains the main logic of the program. It checks an infrared sensor to detect if a bin is open. If the sensor detects that the bin is open, it performs a series of actions, including displaying messages on the LCD, controlling motors to simulate opening and closing the bin, and uploading data to a server.
5. **Server Interaction:** The code includes functions upload(), readserver(), and clearserver() to communicate with a server. The upload() function constructs a URL with data and sends an HTTP request to store data on the server. The readserver() function retrieves data from the server, and the clearserver() function clears data from the server.
6. **Wi-Fi Initialization:** The wifiinit() function initializes the Wi-Fi connection by sending AT commands to the Wi-Fi module. It configures the module to connect to a specific SSID and password.
7. **Buzzer Alert:** The beep() function controls a buzzer, causing it to sound an alert.
8. **Analog-to-Digital Conversion:** The converts() and 5onvert() functions convert unsigned integers to ASCII characters for serial and LCD output, respectively.

4. HARDWARE IMPLEMENTATION

Power Supply:

- Bridge rectifier converts AC voltage from the mains to pulsating DC.
- 7805 voltage regulator stabilizes the pulsating DC to 5V.
- Capacitors smoothen the regulated voltage.

Microcontroller Unit (MCU):

- Arduino Uno receives and processes data from sensors.
- It controls the system's logic and timing.

Sensors:

- Ultrasonic sensor measures the fill level of the trash bin.
- Infrared sensor detects if the bin lid is open or closed.

Actuators:

- LED lights indicate the bin's status (e.g., full, empty).
- Motor and driver circuit control a mechanism (not shown) like a compactor or bin lifter.

Additional components:

- LCD displays information like fill level and collection schedule.
- Reset button restarts the system if needed.
- Bridge connects the circuit to the mains power.

Here's how the system might work:

1. The ultrasonic sensor continuously measures the fill level of the bin.

2. The cloud server processes the data and sends a collection request to the waste management company.

3. A waste collection truck is dispatched to the bin's location.

This is the pin diagram where all the hardware components are been connected components. This ARDUINO microcontroller having 28 pins. In which 14 GPIO pins as digital pins and 5 GPIO pins. 15MHz crystal oscillator connected internally. The step-down transformer, Bridge rectifier capacitor with 1000f Resisters and led are connected in Regulated power supply which provide the 5v to the Arduino and all input/output modules.

15*2 LCD Monitor has connected with the Digital pins 2, 3, 4,5,5,6.

WIFI has connected to Digital Pins D0, D1 internal Transmitter and receiver pins.

Motor connected to A0 and A1 pins of the Arduino micro controller.

IR sensor connected to digital pin 12

Buzzer alarm connected to digital pin 13

Ultrasonic sensor connected to 10,11

DC gear motor connected to A0, A1

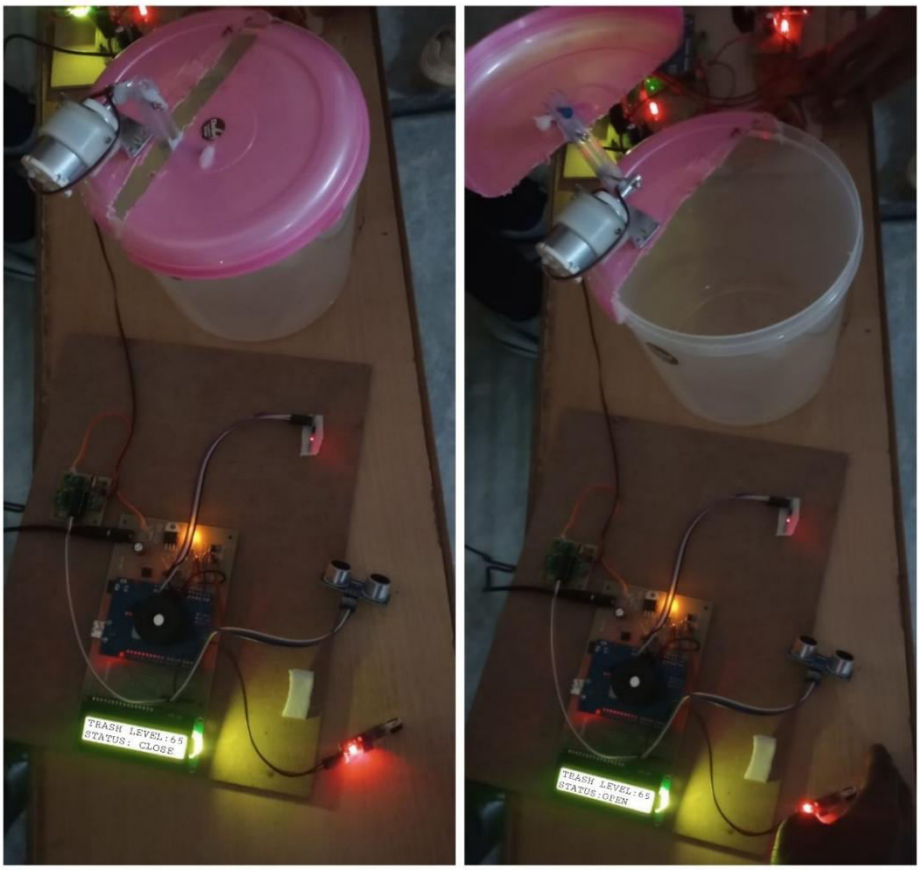

Figure :3.person detection by IR sensor

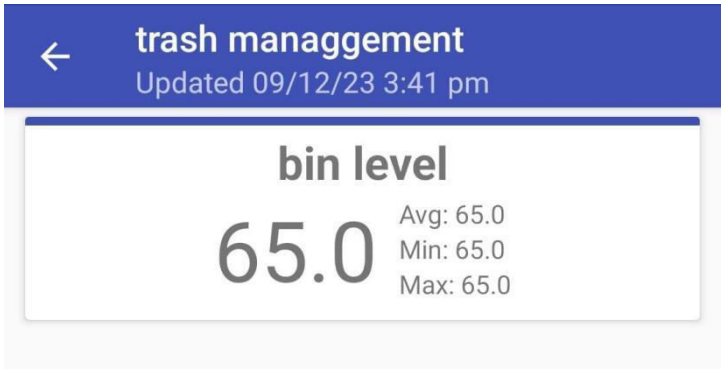

Figure :4.pocket IoT

5. CONCLUSION

The bin monitoring system has the capability to track the garbage level and prevent overflow by sending an SMS notification to the collector. It also provides the precise location of the bin. This project aims to develop a IoT-based system for managing garbage and waste collection bin overflow. By utilizing IoT technology, real-time information about the status of the bins, such as when they are full, can be obtained. This enables appropriate action to be taken promptly. The IoT-enabled smart trash management system with real-time location tracking offers a modern solution for waste management. It effectively utilizes IoT technology to monitor and manage trash disposal efficiently. The inclusion of a control room in the Central Office allows for effective monitoring of the garbage level. Additionally, integrating the system with a website application provides an exact location on the map.

Automatic alerts are designed in this project to notify the garbage collection team through an IoT server. This ensures that garbage is collected only when necessary, rather than following a routine where even half-full bins are collected. IoT-based trash management systems offer numerous advantages over traditional systems, including reduced garbage collection costs, increased recycling rates, minimized environmental impact, and improved public health. By diverting biodegradable and other materials from landfills, IoT-based devices also contribute to waste reduction.

REFERENCES

[1] J. A. Nathanson, "Solid-waste management | Britannica.com." [Online]. Available: https://www.britannica.com/technology/solid-waste-management. [Accessed: 21-Apr-2019].

[2] K. Pardini, J. Rodrigues, S. Kozlov, N. Kumar, and V. Furtado, "IoT-Based Solid Waste Management Solutions: A Survey," J. Sens. Actuator Networks, MDPI Open Access Journals vol. 8, no. 1, p. 5, 2019. https://www.mdpi.com/2224-2608/8/1/5

[3] M. Ali, W. Wang, N. Chaudhry, and Y. Geng, "Hospital waste management in developing countries: A mini review," Waste Manag. Res., vol. 35, no. 5, pp. 581–592, Jun. 2016. https://sci-hub.se/https://doi.org/10.1166/0634242x16591344

[4] L. Gan and S. Yang, "Legal context of high-level radioactive waste disposal in China and its further improvement," Energy Environ., journals.sagepub.com, vol. 28, no. 4, pp. 484–498, Jun. 2016. https://sci-hub.se/https://doi.org/10.1166/0958305X16605168

[5] K. Kawai and L. T. M. Huong, "Key parameters for behaviour related to source separation of household organic waste: A case study in Hanoi, Vietnam," Waste Manag. Res., vol. 35, no. 3, pp. 245–252, Mar. 2016. https://sci-hub.se/https://doi.org/10.1166/0634242X15583441

[5] E. P. Trindade, M. P. F. Hinnig, E. M. da Costa, J. S. Marques, R. C. Bastos, and T. Yigitcanlar, "Sustainable development of smart cities: A systematic review of the literature," J. Open Innovation. Technology, Mark, and Complexity, vol. 3, no. 3, 2016. https://jopeninnovation.springeropen.com/articles/10.1185/s40852-016-0053-2

[6] M. Mijac, D. Androcec, and R. Picek, "Smart City Services Driven By IoT: a Systematic Review," SMART CITY Serv. DRIVEN BY IoT A Syst. Rev. J. Econ. Soc. Dev., vol. 4, no. 2, 2016. https://www.researchgate.net/publication/320858851_Smart_City_Services_Driven_by_IoT_A_Systematic_Review

[8] Tejashree Kadus, Pawankumar Nirmal, Kartikee Kulkarni "Smart Waste Management System using IoT", International Journal of Engineering Research & Technology (IJERT), Volume 9, Issue 04, April-2020. https://www.ijert.org/research/smart-waste-management-system-using-IoT-IJERTV9IS040490.pdf

[9] S.R. Jino Ramson, Member, IEEE, S. Vishnu, A. Alfred Kirubaraj, Theodoros Anagnostopoulos and Adnan M. Abu-Mahfouz, Senior Member, IEEE. "A LoRaWAN IoT enabled Trash Bin Level Monitoring System", IEEE Transactions on Industrial Informatics Volume 18, Issue 2, February 2022. https://sci-hub.se/https://doi.org/10.1109/TII.2021.3068555

[10] S. Mohamed Azarudeen, B. Mohan, S. Pujita, P. Swapna, "Automatic smart receptacle using IoT and mobile application", IEEE Xplore Part Number: CFP21K64-ART; ISBN: 968-

0-6381-1326-2 issued 05, 25 May-2021.
https://scihub.se/https://doi.org/10.1109/ICICCS51141.2021.9432136

[11] S. R. Jino Ramson, D. Jackuline Moni, S. Vishnu, Theodoros Anagnostopoulos, A. Alfred Kirubaraj, Xiaozhe Fan, "an IoT-based bin level monitoring system for solid waste management", Journal of Material Cycles and Waste Management, Volume: 23, Issue: 2, Pages: 515 – 525, Nov 22, 2020. https://sci-hub.se/https://doi.org/10.1006/s10153-020-01136-9

[12] Dr. Sudha L K, Mohammed Tahir, Ruchitha E, Varshini R, Syed Saif Ali, "Smart Dustbin Monitoring System using Arduino UNO". International Journal of Engineering Research & Technology (IJERT), Vol. 12 Issue 02, February-2023.
https://www.ijert.org/research/smart-dustbin-monitoring-system-using-arduino-uno-IJERTV12IS020051.pdf

[13] Shruthi B Gowda, Balapriya F, Chaya K R, Harshitha K Yadav, Vinutha H, "Enhanced Smart Waste Segregation and Management using Arduino", International Journal of Engineering Research & Technology (IJERT), ISSN: 2268-0181, Vol. 11 Issue 05, May-2022. https://www.ijert.org/research/enhanced-smart-waste-segregation-and-management-using-arduino-IJERTV11IS050101.pdf

[14] Edoardo Longo, Faith Alperen Sahin, Alessandro E. C. Redondi, Petrizia Balzan, Massimo Bianchini, Stefano Maffei, "A 5G-Enabled Smart Waste Management System for University Campus", MDPI open access journals, Volume: 21, Issue: 24, DEC 10, 2021.
https://www.mdpi.com/1424-8220/21/24/8268