# LORA BASED SOLID WASTE MANAGEMENT

**Deepak k[1] , Mrs. K. Ferents Koni Jiavana[2]**

[1,2]*Embedded System technology, SRM Institute of Technology, Chennai, India*

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***Abstract***:- *The orderliness associated with the control of separation, collection, storage, transfer or transport, and disposal of solid waste substances in a way that successfully addresses the variety of aesthetic, public health, economics, conservation, and other environmental considerations. This paper presents the way that gives the solution to the above-mentioned problems by introducing waste bin system that is used to communicate with the remote server by intimating and maintaining the level and the hygiene in and around the bin with remote access. This allows the remote user to know the status of the bin with a handheld device using the LORA based Communication which offers a high range of data transmission. This allows you to monitor your current collection operations better and gain efficiency while presenting you a scalable, data-driven system to expand your collection network moving forward.*

## I. INTRODUCTION

IoT spans across numerous domains, and solid waste management is one such domain which is an integral part of a smart city infrastructure. Garbage production has become a part of every one life and going by this [1]. There are many hurdles faced by the city municipality in collecting the garbage, transporting it, and managing the entire system. Solid waste management includes collection, storage, segregation, transportation, and recycling of the waste produced. Currently the waste is not segregated, and the collected waste is dumped directly in dump yards creating unnecessary increase in the amount of garbage. We feel that there is an urgent requirement of revamping the system, and with the integration of IoT, the waste management process can be streamlined and better efficiency can be obtained.

Solid waste or house hold garbage mainly consists of wet and dry waste. The wet waste is mostly bio-degradable and can be used to produce compost or bio gas. Some of the dry waste can be recycled and the remaining can be dumped. From the amount of garbage collected daily, there is a potential of producing close to 1,800 Kcal/Kg of energy [2]. The main problem in waste management is segregation of the garbage and collecting it from the garbage bins. Using the data collected from the garbage bins with some data analytics, the garbage trucks can be directed to only those garbage bins that need to be cleared and also be given efficient routes using a mobile app to ensure proper garbage collection takes place and the trucks do not waste time in visiting the garbage bins that are not filled. Using the data collected from the entire process, data mining and data analytics can be done to understand the amount of garbage collected, the types of garbage, the density of garbage collected with respect to the locality, etc., and a proper management system can be put in place. By incorporating IoT into the system, collection, transportation, energy production (from recycled waste), etc. of the waste can be monitored efficiently and accurate statistical models can be created to ensure proper solid waste management.

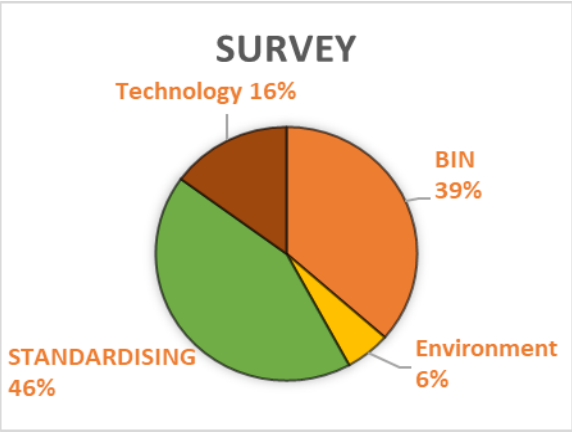
## II. PROBLEM STATEMENT

### A. *Objective*

The main objective of the solid waste management system in the urban area is to promote the Environment Management and municipal corporation. The purpose of the current available system is to identify, quantify, describe and prioritize framework of Environment Sustainability in compliance with the applicable regulations, policies and standards.To introduce and aware people to real concerns of environment and its sustainability, To secure the environment and cut down the threats posed to human health by analyzing the pattern and extent of resource use on the city. To establish a baseline data to assess future sustainability by avoiding the interruptions in environment that are more difficult to handle and their corrections requires high cost. To bring out a status report on environmental compliance.Composting and recycling are the methods adopted by the municipal corporation.

### B. *Public Survey*

There was a public survey conducted to get the detailed information on the problems faced in the reality on the waste management system.



There was a public survey conducted through the google form and a people of 150 numbers responded with each varying result almost such as quality issues and the service issues on management and the lack of standardization on the waste management system. Based on the survey a chart has been created stating the percentage of people opting for the different problems majorly Standardization, environment support, garbage bin and technology used by the government.

### III. DESIGN AND ARCHITECTURE

The sensors and actuators will be interfaced to a controller that will collect the sensor data and send it to a gateway using LoRa transceiver module. A gateway module with a LoRa transceiver will be used to receive the sensor data from several garbage bins. Local processing of the data will be done here and the processed data will be sent to the cloud over TCP/IP using the MQTT protocol.

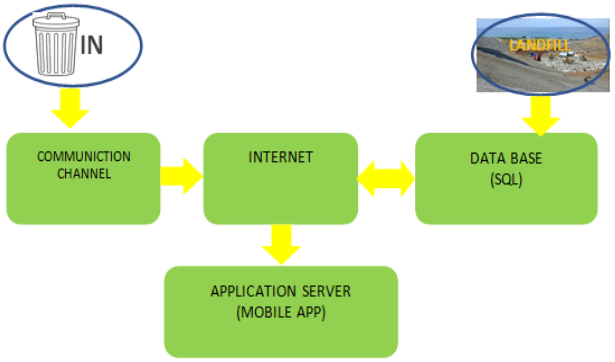


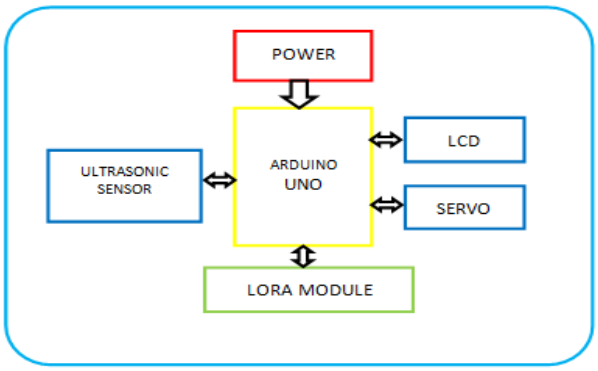

Fig 2

The bins will be fitted with IR sensors to detect the level of garbage collected. A gas sensor will be used to detect the presence of any harmful gases, a load cell will be used to measure the weight of the bin, and indicators like LCD display will be used for notifications.

An MQTT broker will be running in the cloud that collects the data and a NoSQL database will be implemented to store those data. Rule engines will be used for analytics, and the collected data will be displayed on a dashboard / UI.

### IV. SMART BIN MODULE

This smart bin is used to gather information of the usage of bin that has been installed to the consumers. It logs the data such as amount of waste that has been used and the reports are shared to the municipal corporation through the near my LoRa gateway. Then the data are also shared to near my truck drivers to clear the bin when it reaches the level.




SMART BIN

Fig 3

The smart bin is developed with the major concern to avoid the overflow of garbage, with the limitation in order to reduce the overflow in future. This module consists of sensor modules to record the data accurately and perform actions accordingly. This module consists of the ultrasonic sensor that detect and measure the level of the bin that is filled with garbage. The LCD displays the exact amount of space available in the bin.

### V. LORA MODULE IOT

LoRa is a long range low power wireless technology platform that uses unlicensed radio spectrum in the industrial, scientific, and medical radio band (ISM band) [3]. LoRa aims to eliminate repeaters, reduce device cost, increase battery lifetime on devices, improve network capacity, and support a large number of devices. It is a physical layer used for long-range communication. To achieve low power, most wireless technologies use Frequency Shift Key (FSK) modulation. However, LoRa uses Chirp-spread-spectrum (CSS) modulation to maintain low power characteristics for the benefit of increasing communication range. It is the first implementation for low-cost infrastructure to be commercialized using CSS. CSS has been used in long-range communications by military and space agencies due to its ability to withstand interference.

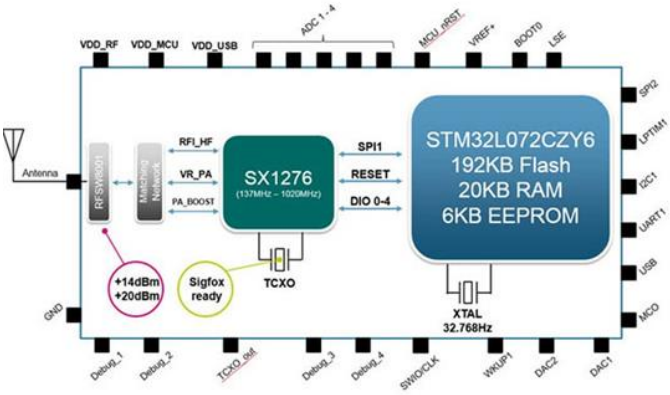



Fig 4

LoRaWAN protocol is a wireless communication protocol developed by LoRa Alliance to serve for challenges faced with long-range communication faced with IoT. It specifically deals with long range, low power consumption at a low bit rate due to its LoRaWAN-based system architecture. The protocol and its network architecture have a great influence in determining a node battery lifetime, network capacity, quality of service (QoS), security, and a variety of applications served by the network. The fig 4 shows the frequency of the used and the guard band in the bandwidth spectrum. The $B_u$ is the useful band that is used for the communication as depicted and $B_G$ is the guard band that separates to useful band in order to avoid the channel interference of these useful frequency. The main concept is that to use the guard band in the LTE bandwidth spectrum for the purpose of communication.

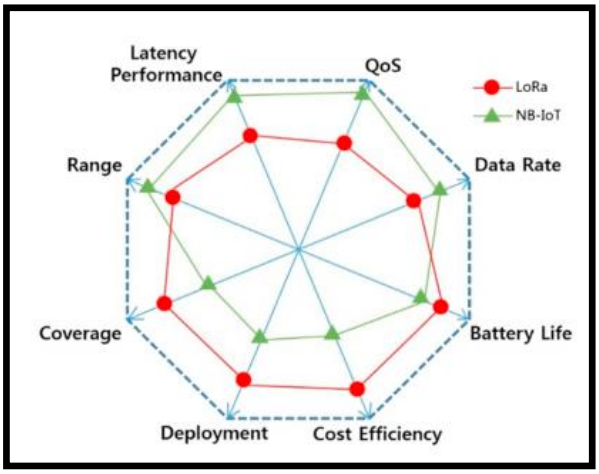



Fig 5

## VI. WEB SERVER AND APPLICATION

A server is created with some processor such as raspberry pi is and apache version 2 server. The data base is created using the PHP 5 and is maintained using My PHP admin and all the data stored and retrieved in the server is carried out using the SQL [5]. An android application is created with the basic GUI presenting all the details that is collected from the water meter which is regularly updated in the server with LORA communication channel. The application provides details of the availability of the bin to the customer, truck collector & control room log in credentials. This application is also used to remotely access and notifies the exact level of the bin special authentications which ensures the limited [2].

*1) Lora Server*

LoRa Server is an open source LoRaWAN network server. This server is responsible in scheduling of downlink data transmissions and for handling (and de-duplication) of uplink data received by the gateway(s).

Lastly, Grafana is installed to display the data collected in graph view. The dashboard that are used for this project is Grafana. All the data from the Lora server will connect to this dashboard through InfuxDB. It will show all the information about a node device [5].

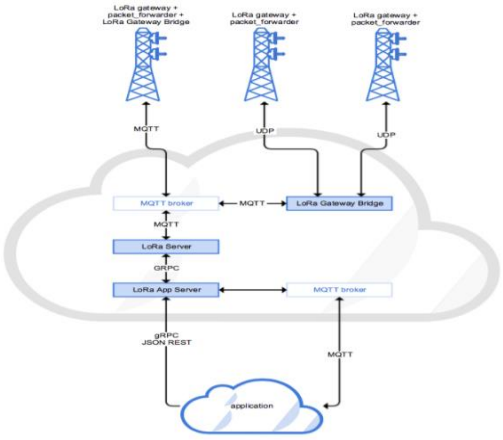



**Fig 6:** LoRa Server Architecture

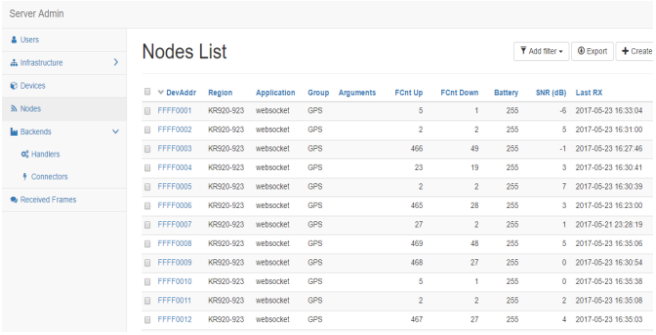



**Fig 7:** LoRa Interfacing Lora server

After installing this 3 main LoRa program, 3 more program need to be installed in the Linux to ensure this system is fully functioned. First, Influx Data, the creators of Influx DB are installed. It can deliver a modern open source platform built from the ground up for metrics and events (time series data). It used to build IoT monitoring applications faster, easier, and to scale. Secondly, red Node is installed for decode an encrypted data send by the microcontroller. Node-RED offers a browser-based flow editor that makes it easy to wire together flows using the wide range of nodes in the palette. Flows can be then deployed to the runtime in a single click. JavaScript functions can be created within the editor using a rich text editor. A built-in library allows you to save useful functions, templates or flows for re-use [8].

## VII. CONCLUSION

Based on the study and the design the waste management system is designed here is more efficient and cost effective when compared to the other existing module. This is because of the interface of the new technology LORA

MODULE that has been developed in order to have long range and data rates with minimal consumption of power. This module will provide the end consumer a quality of details that may help the public to live in a neat and clean environment. This module provides greater hope in establishing the monitoring of all the data in real time and serve the purpose effectively in the long range IOT bandwidth.

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