LITERATURE SURVEY
Smart Waste Management System For Metropolitan Cities Technology: IOT

1. **Cloud based smart waste management for smart cities**
   https://ieeexplore.ieee.org/document/8645576
   Authors: Mohammad Aazam, Marc St-Hilaire, Chung-Horng Lung, Ioannis Lambadaris

   This paper focuses on waste management in urban cities,With increasing population and also changes in lifestyle municipal solid waste generation is increasing significantly.Hence waste management is a challenge in urban cities.The overall waste management involves three main types of entities,they are people who generate waste,waste collectors/city admin,stakeholders. Most of the waste is of organic matter, comprising 44.4%.These data of contents in the waste management is sent to stakeholder using cloud and also in order to have a complete waste management mechanism, it is very important to have a smart way of notifying the quantity of each type of waste and involve the stakeholders effectively. They say that we can perform big data analysis on the data gathered from waste management.These analysis of the overall waste management can then be used to create further services from the cloud and analyze it in a more depth way to perform waste recycling..The methodologies that were mentioned in this paper were hadoop cluster and also performing analytics on the database from hadoop cluster.

2. **Smart Waste Management System for Crowded area Makkah and Holy Sites as a Model**
   https://ieeexplore.ieee.org/document/8389897
   Authors: Dr. Rasha Elhassan, Dr. Mahmoud Ali Ahmed, Mrs. Randa Abdalhalem

   This paper focuses on how to handle waste in holy sites and makah as a model .During waste management there are three key challenges we face here , small area, short period of time and the increasing of the Pilgrimages' member.The system proposed by them will use sensors inside the container to separate the waste into 4 categories (food, plastics, papers, and metal) and use actuator at a top level to inform the management system to collect the container. The main technologies used and proposed by them was Internet of Thing,Sensor, Big Data.The different sensors used for categorize the waste are Capacitive proximity sensors separate papers and plastic inside the trash can, the metal sensor is used to detect metal,the infrared sensor detects glass.Then after categorizing the waste through GSM/GPRS the Arduino IDE system sends SMS to the waste vehicle through Radio Frequency receiver when the trash can is full.

3. **Optimal Route Recommendation for Waste Carrier Vehicles for Efficient Waste Collection:A Step Forward Towards Sustainable Cities - 15.04.2020**
https://ieeexplore.ieee.org/document/9068215

Authors: Shabir Ahmad , Imran , Faisal Jamil , Naeem Iqbal , And Dohyeun Kim

In this paper the focus is carried out on the real world solid waste of Jeju Island, South Korea. It contributes to the generation of optimized routes for the waste carrier vehicles. The existing data of the residential grids are utilized to predict the behavior of people in waste disposal. A prediction model is built with all the data collected from the grid by optimizing and pre-processing the raw data and the output of the predicted system is the total waste weights.

4. **An Internet of Things Based Smart Waste Management System Using LoRa and Tensorflow Deep Learning Model - 12.08.2020**
https://ieeexplore.ieee.org/document/9165744

Authors: Teoh Ji Sheng , Mohammad Shahidul Islam , (Graduate Student Member, Ieee), Norbahiah Misran , (Senior Member, Ieee), Mohd Hafiz Baharuddin , (Member, Ieee), Haslina Arshad , Md. Rashedul Islam , Muhammad E. H. Chowdhury, (Member, Ieee), Hatem Rmili , (Senior Member, Ieee), And Mohammad Tariqul Islam, (Senior Member, Ieee)

The traditional waste management system is replaced with smart sensors embedded into the system to perform real time monitoring and better waste management. The aim of this research is to develop a smart waste management system using the LoRa communication protocol and TensorFlow based deep learning model. LoRa sends the sensor data and Tensorflow performs real time object detection and classification. The bin consists of several compartments to segregate the waste including metal, plastic, paper, and general waste compartments which are controlled by the servo motors.
Object detection and waste classification is done in the TensorFlow framework with a pre-trained object detection model. This object detection model is trained with images of waste to generate an inference graph used for object detection which is done through a camera connected to the Raspberry Pi 3 Model B+ as the main processing unit. Ultrasonic sensor is embedded into each waste compartment to monitor the filling level of the waste. A GPS module is integrated to monitor the location and real time of the bin. LoRa communication protocol is used to transmit data about the location, real time and filling level of the bin. The RFID module is embedded for the purpose of waste management personnel identification. The camera module is connected to Raspberry Pi to capture the waste which is thrown for object detection and identification, based on the object the Raspberry Pi will actuate the opening or closing of the garbage bin. Only authorized personnel are allowed to access the garbage bins using RFID. An ultrasonic sensor is used to detect the level of the garbage in the bins and GPS is used to get the location of the bins in real-time. The

limitations are, this model is not ideal for household garbage collection, filling of individual compartments require it to be disposed at different times which is not an efficient way.

5. A CNN-Based Smart Waste Management System Using TensorFlow Lite and LoRa-GPS Shield in Internet of Things Environment - 15.11.2021
https://ieeexplore.ieee.org/document/9615047
Authors: Nicholas Chieng Anak Sallang , Mohammad Tariqul Islam , (Senior Member, Ieee), Mohammad Shahidul Islam , (Member, Ieee), And Haslina Arshad

Another Smart Garbage System designed where the top compartment stores most of the electronic components, the remaining compartments are used to store different types of waste . Tensor Flow Lite is chosen to be used on a low power mobile platform to detect the model, the CNN architecture of MobileNetV2 is designed to have classification performance on low power mobile devices.

6. Optimal Policy-Making for Municipal Waste Management Based on Predictive Model Optimization
https://ieeexplore.ieee.org/document/9284435
Authors: Shabir Ahmad, Imran , Naeem Iqbal , Faisal Jamil , And Dohyeun Kim

It is to define policy in terms of the number of waste collection human resources cost, waste carrier's vehicle cost and fuel cost. Thus, the paper aims to suggest the number of resources which lead to a minimum cost and also ensure a certain level of hygiene in the area. The analysis is carried out on the solid waste dataset of 2017-2019 generated from different residential grids in Korea.The sensors installed on bin record the time of the waste hit, the amount of waste and other information such as grid ID in which the bin is placed. This information is sent to municipal authorities to collect grid statistics such as population of grid, male and female members, grid coordinates, the waste amount for weekdays, and monthly data for 2017 to 2019 in a periodic manner.

7. 'IOT Based Smart Waste Management System' 2021
https://ieeexplore.ieee.org/document/9528293
Authors: Gayathri N , Divagaran A R, Akhilesh C D, Aswiin V M, Charan N

They have designed a smart waste management system that monitors the amount of food waste in a particular organization. RFID technology is used by the user to scan and open the bin thereby allowing to keep track of every individual's food wastage and a load cell is used to measure the amount of food wastage. Thus this project allows an organization to keep track of waste generated, an individual's contribution and an analysis report is generated.

8. **'Recycle.io: An IoT-Enabled Framework for Urban Waste Management 2018'**
https://ieeexplore.ieee.org/document/8622117
Authors: Eyhab Al-Masri, Ibrahim Diabate, Richa Jain, Ming Hoi Lam and Swetha Reddy Nathala

They have designed an Internet of Things (IoT)-enabled waste management system called recycle.io, that alerts of real time waste segregation violation and aims to manage waste in a cost efficient manner. It makes use of an edge computing device which includes the Raspberry pi, ultrasonic sensor and an IR camera. The sensor triggers the camera to take pictures of the disposed waste item and is processed by the edge devices before it is sent to the cloud for further advanced analytics like dynamic scheduling and dynamic routing. The proposed system improves the network traffic since all the processing is done locally before it is sent to the cloud and also boasts a 'serverless technology'.

9. **'IoT-Aware Waste Management System Based on Cloud Services and Ultra-Low-Power & RFID Sensor-Tags'**
https://ieeexplore.ieee.org/abstract/document/9144506
Authors: Luca Catarinucci , Member, IEEE, Riccardo Colella , Senior Member, IEEE, Stefano Irno Consalvo, Luigi Patrono , Member, IEEE, Claudia Rollo, and Ilaria Sergi.

They have proposed a solution for door-to-door waste collection and management. It includes a RFID tag on the waste bin with a fitted sensor that collects the weight of the bin and a RFID reader band that picks up the readings and transmits to the cloud. This system improves the cost of overall waste collection and helps impose a fair waste tax collection system.
The paper 'A LoRaWAN IoT enabled Trash Bin Level Monitoring System' by S.R. Jino Ramson, S. Vishnu, A. Alfred Kirubaraj, Theodoros Anagnostopoulos and Adnan M. Abu-Mahfouz, focuses on the development of a self-powered, LoRaWAN IoT enabled Trash Bin Level Monitoring System. It consists of various sensors and a microprocessor which is used for getting the level and geographical location of a trash bin, processes the data and transmits to a LoRaWAN gateway and is relayed to a server. The users can view and analyze the status of every bin and its

geolocation by using a smart graphical user interface. The LoRaWAN based system improves on the life expectancy, battery charging and performance.

10. **Survey on waste management monitoring System based on IOT**
https://www.ijirts.org/volume8issue3/IJIRTS204202.pdf

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Solid waste management is the collecting,treating and disposing of solid material that is discarded.As there are some improper disposal of municipal solid waste which can create unsanitary conditions.For evacuating purpose the bins been installed a continuous mountain of the waste levels.The location of the dustbins with the help of the GPRS VKE module which helps the Municipality to locate the Dustbins.With the help of GSM SIM module, the percentage of the dust bins filled will be sent to the truck driver to take the waste from the bins.Thus this project allows an organization to keep track of waste generated, an individual's contribution and an analysis report is generated.