SMART WASTE MANAGEMENT SYSTEM FOR METROPOLITAN CITIES

INTRODUCTION

The Internet of Things (IoT) describes the network of physical objects “things” that are embedded with sensors, software, and other technologies to connect and exchange data with other devices and systems over the internet. These devices range from ordinary household objects to sophisticated industrial tools. With more than 7 billion connected IoT devices today, experts are expecting this number to grow to 10 billion by 2020 and 22 billion by 2025. IoT has become one of the most important technologies of the 21st century. Now that we can connect everyday objects kitchen appliances, cars, thermostats, and baby monitors to the internet via embedded devices, seamless communication is possible between people, processes, and things. Technologies that have made IoT possible are Access to low-cost, Low-power sensor technology, Connectivity, Cloud computing platform, Machine learning and analytics, and Conversational artificial intelligence (AI). IoT can greatly optimize collection services and reduce operational costs for cities, transitioning waste management into data-driven collection processes. Waste collection is an essential city service, yet existing waste management systems are resource intensive, inefficient, and outdated. Garbage collection is a time-consuming and inefficient procedure. Trucks empty bins whether they are full or nearly empty due to the consistent method of predefined routes and days. Many of those pit stops are a waste of gasoline, time, and effort, all of which add up to a large amount of money. Failure to separate recyclables from rubbish harms the bottom line and reduces the lifespan of landfills. Recycling companies can't use rubbish that hasn't been separated. While some waste can be sorted at the point of collection, the procedure is inefficient and costly, a situation made worse by China's 2018 ban on the import and processing of foreign recyclables. Because of operational inefficiencies in trash collection procedures, the expanding usage of IoT, smart devices and sensors, and machine-to-machine communication has the potential to save money. And the key to it is the city's waste collection system, which is both complex and time and resource-intensive. The information obtained from the "smart" dumpsters also aids in the reduction of missed pickups. If the sensors detect that the garbage is full, the authorities will be notified automatically. The IoT waste management system will then be able to schedule this location for the next pickup. This streamlines the waste management process and eliminates garbage bin overflow. A sensor can be attached to a dumpster to measure its fill level, which can be useful for municipalities or garbage management firms. These "smart" dumpsters may then provide waste collectors with real-time fill-level information. Using this information, the IoT enterprise solution can determine the best paths for garbage collectors to take to prioritize regions in need of cleanup while avoiding disposal units that still have space. This results in a more efficient pickup operation that doesn't take into account empty garbage containers, saving both gasoline and manpower.

LITERATURE SURVEY

Smart Waste Management System by Internet Of Things

1) J. A. Nathanson, “Solid-waste management | Britannica.com.”

The proper solid-waste collection is important for the protection of public health, safety, and environmental quality. It is a labor-intensive activity, accounting for approximately three-quarters of the total cost of solid-waste management. Public employees are often assigned to the task, but sometimes it is more economical for private companies to do the work under contract to the municipality or for private collectors to be paid by individual homeowners. A driver and one or two loaders serve each collection vehicle. These are typically enclosed, compact trucks, with capacities up to 30 cubic meters (40 cubic yards). Loading can be done from the front, rear, or side. Compaction reduces the volume of refuse in the truck to less than half of its loose volume.

2) L. A. Manaf, M. A. A. Samah, and N. I. M. Zukki, “Municipal solid waste management in Malaysia: Practices and challenges,” Waste Manag., vol. 29, no. 11, pp. 2902–2906, Nov. 2009.

Rapid economic development and population growth, inadequate infrastructure and expertise, and land scarcity make the management of municipal solid waste become one of Malaysia's most critical environmental issues. The study is aimed at evaluating the generation, characteristics, and management of solid waste in Malaysia based on the published information. In general, the per capita generation rate is about 0.5-0.8 kg/person/day in which domestic waste is the primary source. Currently, solid waste is managed by the Ministry of Housing and Local Government, with the participation of the private sector. A new institutional and legislative framework has been structured with the objectives to establish a holistic, integrated, and cost-effective solid waste management system, with an emphasis on environmental protection and public health. Therefore, the hierarchy of solid waste management has given the highest priority to source reduction through 3R, intermediate treatment, and final disposal.

3) S. Sharmin and S. T. Al-Amin, "A Cloud-based Dynamic Waste Management System for Smart Cities," in Proceedings of the 7th Annual Symposium on Computing for Development - ACM DEV '16, 2016, pp. 1–4.

A Cloud-based Dynamic Waste Management System for Smart waste management problems is a cut in the cities and urban areas nowadays. Several trucks roaming around, collecting waste at any time, excessive manpower requirements, and inefficient monitoring are some of the difficulties we face with the conventional waste collection approach. The purpose of our work is to introduce a smart and intelligent waste management system that can handle the process dynamically and cost-effectively. In our approach weight and volume of waste thrown in the wastebin are collected by economical sensors and then sent to a cloud server using a microcontroller and GPRS. These details are used to find the waste collection schedule to maximize the collection. The location of vehicles and waste bins are used to find the shortest possible collection route for each truck which is implemented by Ant Colony Optimization(ACO)technique. The system is adaptable to dynamic changes i.e. routes blocked during the waste collection process. The whole process can be monitored centrally and thus provide a high-quality service to the citizens of a smart city.

4) B. R. Balakrishnan Ramesh Babu, A. K. Anand Kuber Parande, and C.A. Chiya Ahmed Basha, "Electrical and electronic waste: a global environmental problem," Waste Manag. Res., vol. 25, no. 4, pp. 307–318, Aug. 2007.

The production of electrical and electronic equipment (EEE) is one of the fastest-growing global manufacturing activities. This development has increased the waste of electric and electronic equipment (WEEE). Rapid economic growth, coupled with urbanization and growing demand for consumer goods, has increased both the consumption of EEE and the production of WEEE, which can be a source of hazardous wastes that pose a risk to the environment and sustainable economic growth.

To address potential environmental problems that could stem from improper management of WEEE, many countries and organizations have drafted national legislation to improve the reuse, recycling, and other forms of material recovery from WEEE to reduce the amount and types of materials disposed of in landfills. Recycling waste electric and electronic equipment is important not only to reduce the amount of waste requiring treatment but also to promote the recovery of valuable materials. EEE is diverse and complex concerning the materials and components used and waste streams from the manufacturing processes. Characterization of these wastes is of paramount importance for developing a cost-effective and environmentally sound recycling system. This paper offers an overview of electrical and e-waste recycling, including a description of how it is generated and classified, strategies and technologies for recovering materials, and new scientific developments related to these activities.

5) K. Kawai and L. T. M. Huong, "Key parameters for behavior related to source separation of household organic waste: A case study in Hanoi, Vietnam," Waste Manag. Res., vol. 35, no. 3, pp. 246–252, Mar. 2017.

Proper management of food waste, a significant component of municipal solid waste (MSW), is needed, especially in developing Asian countries where most MSW is disposed of in landfill sites without any pre-treatment. Source separation can contribute to solving problems derived from the disposal of food waste. An organic waste source separation and collection program has been operated in model areas in Hanoi, Vietnam, since 2007. This study proposed three key parameters (participation rate, proper separation rate, and proper discharge rate) for behavior related to source separation of household organic waste, and monitored the progress of the program based on the physical composition of household waste sampled from 558 households in model program areas of Hanoi. The results showed that 13.8% of 558 households separated organic waste, and 33.0% discharged mixed (unseparated) waste improperly. About 41.5% (by weight) of the waste collected as organic waste was contaminated by inorganic waste, and one-third of the trash disposed of as organic waste by separators was an inorganic waste. We proposed six hypothetical future household behavior scenarios to help local officials identify a final or midterm goal for the program. We also suggested that the city government take further actions to increase the number of people participating in separating organic waste, improve the accuracy of separation and prevent non-separators from discharging mixed waste improperly.