Smart Waste Management

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Smart Waste Management Using WSN and IoT

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***Abstract*— Rapid increase in population, has led to the improper waste management in cities resulting in increased pests and spreading of diseases. Nowadays, the Garbage Collecting Vehicle (GCV) collects the waste twice or thrice in a week. So, the problem is over flowing of wastages on the roads. Hence, to overcome this limitation, in this paper a scheme on smart waste management using Wireless Sensor Networks (WSN) and IoT (Internet of Things) is proposed. The garbage bins are deployed with sensors and are networked together using WSN. The sensors deployed in the garbage bins collect the data for every determined interval. Once the threshold is reached, it raises a request to the GCA (Garbage Collector Agent). This agent collects the requests of all the filled vehicles and communicate using IoT framework. The experimental simulation is done in proteus tool. A hardware prototype is developed for the proposed framework. Analysis of the proposed scheme provides better results in waste management.**

***Index Terms* – Wireless Sensor Networks, Smart Waste Management, Garbage Collection.**

I. INTRODUCTION

Solid waste is a general term that encloses all waste materials except unsure waste, liquid waste and region emissions. Solid wastes are often additional divided into two general groups: residential and business. The residential cluster refers to the waste that's labeled as 'garbage'. The rubbish category are often represented because the waste that's collected by the community services. The business cluster contains industrial and agricultural customers. These purchasers are far more spread and manufacture higher amounts of waste. The foremost necessary distinction between urban routes and business routes is that the waste management company serves locations i.e. business rather than streets or quarters i.e. residential.

Disposing of perishable waste product creates odor nuisance. User inconvenience caused by advanceddischarge method needs a lot of maintenance valuethan the present system. Fuel connected issues, energy constraint over the detector nodes limits the period of time of the WSN. Improvement of routes should be followed by the truck once it involves collect wastage, wherever business waste assortment issues squaremeasure established, the situation of the selling facilities square measure a lot of necessary than within the case of urban waste assortment, due to the upper range of disposal journeys that ought to be integrated. the employment of multiple disposal locations will improve assortment efficiency traditionally, as a result of associate degree unloading trip needs to be create to a disposal location when every client.

II. RELATED WORKS

This section discusses about the existing approaches in the field of smart waste management.

Insung Hong et.al [1] has suggested that replacing SGS(Smart Garbage Sensor) instead of RFID garbage collecting system helps to improve their energy efficiency up to 16% and can reduce the food waste reduction .Inside the SGS they have installed SGBs(Smart Garbage Bins) to control the energy efficiency of the system.

Dario Bonino et.al [2] has suggested that it provides end-to-end security and privacy that is built upon dynamic federation smart city platform .Its benefits is that it has good dependability and has resilience on failure of a system over a particular month. It focuses on the collection of wastages and accomplishment of ontology method.

Alvaro Lozano Murciegoet.al [3] has suggested that to collect the dustbins that are been filled using a truck. The main advantage is that it reduces the fuel cost of the trucks rather than travelling a long distance it makes the path more simpler and easier to reach the dustbin using route optimization.

TheodorosAnagnostopoulos et.al [4] has suggested that it first starts with an assumption that the smart city must include the IoT base. It uses dynamic scheduling. It is based on the fact that the garbage will be collected only when it is fully filled or the maximum capacities of the dustbins are filled.

Rachael E. Marshall et.al [5] outlines that the smart waste management system in the high salaried countries and an developing countries.

Lilliana Abarca Guerrero et.al [6] outlines the fact that the developing countries undergo an prominent factor of affecting the waste management systems due to rising population levels and fastly growing urbanization. The collaborator of the waste management are many such as household, industry sectors, educational and research intuitions etc produces huge number of wastages. Collecting, Transferring, Transportation of the wastages and they are finally disposed in an open land.

Ala Al-Fuqaha et.al [7] proposed that sketch of the IoT with a stress on technology, application and protocol concern. It explains about the differences between IoT and developing technologies like cloud computing and data analytics.

Jose M. Gutierrez et.al [8] proposed the functional smart city and the use of an smart waste management .It uses IoT for sensing the wastage level in the dustbins, processes the data and sends it to the server for storing and process the data. The process is carried out by the Geographical Information system.

Vikrant Bhor et.al [9] has suggested that when the system ensures that the garbage bins are fully filled up to their maximum it must be cleaned using IR sensor, GSM mode and microcontroller. When it is not filled it must be reported to the higher authority of a particular contractor. Its concludes that it has a clean environment and it decreases the total number of trips the garbage collector vehicle rounds.

Fachmin Folianto et.al [10] has suggested that it uses mesh network .It is used to produce data and deliver it to the mesh network. Whenever the bins are filled they need to be cleaned. The bin collector gives the route to collect the bins.

In [11-14], the routing protocols and the failure detection in sensor nodes are discussed.

III. CHALLENGES, SOLUTIONS AND ISSUES

A. Challenges :

The challenges that are faced while operating with Wireless Sensor Networks (WSN) are listed below

i. **Energy:** Sensors require power for various operations. Energy is consumed in data collection, data method, and data communication. Batteries providing power need to be changed or recharged once they have been consumed. Sometimes it becomes powerful to recharge or change the batteries as a result of demographic conditions. The most critical research challenge for the WSN analysts is to design, develop and implement energy adequate hardware and software protocols for WSNs.

ii. **Self Management**: Wireless sensor networks once deployed should be in a position to work with none human intervention. It should be in a position to manage the network configuration, adaptation, maintenance, and repair by itself.

iii. **Security**: Confidentiality is required in sensing element networks to defend info traveling between the sensor nodes of the net work or between the sensors and the base station; otherwise it may lead to eavesdropping on the communication. In sensor networks, It is essential for each sensing element node and also the base station to possess the ability to verify that the info received was really sent by a trusted sender and not by a human that tricked legitimate nodes into accepting false knowledge. A false data will amendment the manner a network may be predicted.Integrityofdata oughtto bemaintaine d. Data oughtto not amendment and correct knowledg e should reach at user end.

iv. **Quality of Service (QoS)**: Quality of service is the level of service provided by the sensor networks to its users. WSN are being used in various real time and vital applications, so it is mandatory for the network to offer sensible QoS.

v. **Fault Tolerance**: Sensor network ought to keep functional even if any node fails whereas the network is operational. Network should be in a position to adapt by changing its property in case of any difficulty. In that case, well- efficient routing algorithmic program is applied to change the final contour of network.

vi. **Limited Memory and Storage Space**: A sensor is a tiny device with only a tiny low quantity of memory and storage space for the code. In order to make an effective security mechanism, it is necessary to limit the code size of the security algorithm.

B. Solutions:

Here are the few solutions to overcome the problems faced by WSN:

- **Data Freshness:** Even if knowledge Confidentiality and Data Integrity is assured, there is a desire to make sure the freshness of every message. Informally, knowledge freshness suggests that the data is recent, and it ensures that no old messages have been replayed. To solve this problem another time-related counter, can be other into the packet to make sure knowledge freshness
- **Secure Localization**: Often, the utility of a device network can trust on its ability to accurately mechanically find every sensor within the network. A sensor network designed to find faults can would like correct location data in order to pin purpose the placement of a fault.
- **Privacy**: Like other ancient networks, the sensor networks have conjointly force privacy issues. Initially the sensing element networks area unit deployed for legitimate purpose may later on be used in out of the blue ways that. Providing awareness of the presence of sensor nodes and knowledge acquisition is notably vital.
- **Secure routing**: Routing and data forwarding is a crucial service for facultative communication in device networks.
- **Data Availability**: Availability resolves whether or not a node has the capacity to use the resources and whether or not the network is obtainable for the messages to speak. However, failure of the base station or cluster leader's availability can eventually threaten the complete sensing element network. Thus availableness is of primary importance for maintaining associate degree operational network.

C. Issues

The given below are the list of issues that were represented in the previous papers.

- Requires a lot of maintenance price.
- Excess discharge of garbage within the public areas creates a fragile condition for the folks of close to by areas.
- It accomplishes completely different technologies like Java, relational database…etc.
- The bins are clean only if it's totally stuffed.
- During special days the bins are quickly stuffed and that we ought to increase the gathering time periods.
- It is employed to browse,collect,transfer information

over the net.

- While not web it's impractical. High fuel price once it Involves the quantity of the gap lined by the bin collector.
- It includes differing kinds of stake holders with completely different concentration on their interest.

IV. PROPOSED SYSTEM OVERVIEW

A wireless sensor network is a collection of large number of sensor nodes and at least one base station. The sensor node is an autonomous small device that consists of mainly four units that are sensing, processing, communication and power supply. These sensors are used to collect the information from the environment and pass it on to base station. A base station provides a connection to the wired world where the collected data is processed, analyzed and presented to useful applications. Thus by embedding processing and communication within the physical world, Wireless Sensor Network (WSN) can be used as a tool to bridge real and virtual environment.

Wireless Sensor Networks are wireless networks that usually consist of a great number of far distributed devices that are equipped with sensors (instruments that measure quantities in our environment) to monitor physical or environmental phenomenon's. Here, the bins are deployed with sensors and are networked together using WSN(Wireless Sensor Networks) to collect the waste from the bins. And later, by using these sensors in garbages, the system will get an indication through PC or mobile whenever a particular level is filled in garbage collector.

V. SYSTEM ARCHITECTURE

In this section, the architecture and framework of the proposed system is discussed. The different components of the system include a smart garbage bin, GCA, visualization of the IoT framework.

Fig. 1 shows the sender side of the proposed system architecture. The smart garbage bin is installed with a infrared sensor which detects the level of the garbage collected in the bin. These infrared sensors are connected to the microcontroller unit. A power supply is given to the micro controller to make operate the sensors and LCD display. The LCD display shows the level how much the bin has filled.

In sender side, the data is sent to the receiver that how much level of the bin has been filled by using the WSN and IoT. In receiver side, user gets an indication through a mobile or laptop. According to the indications he received, he can notice the how much of the level of the bin have filled.

A power supply is given to the micro controller to make operate the sensors and LCD display. The data collected by the sensors are transferred to a central processing unit which runs the GCA.

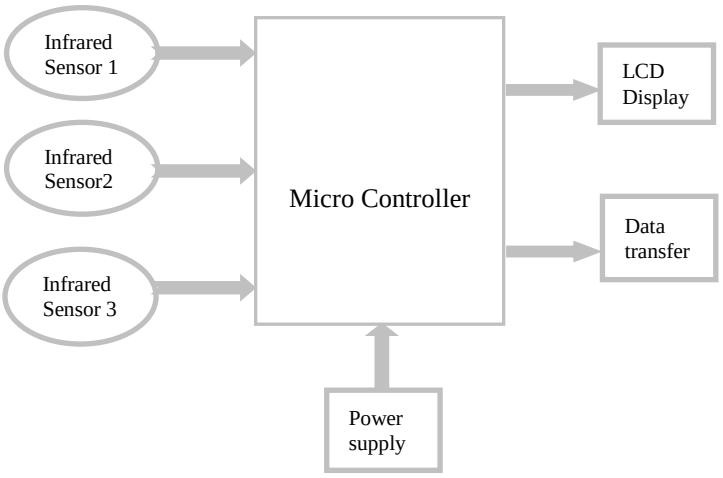

Fig.1 Sender side

Using internet the data processed is sent for visualization to the handheld device of the municipal employee as shown in Fig. 2.

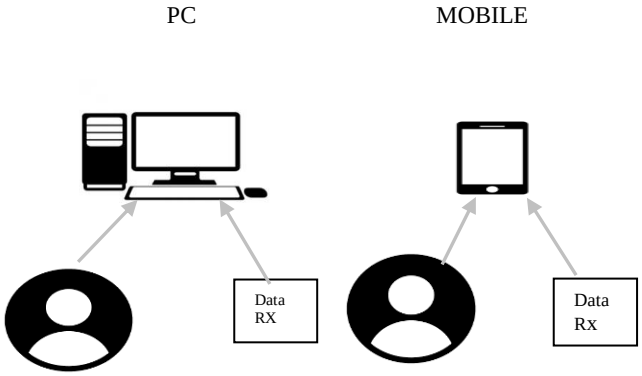

Fig. 2. Receiver side

VI. MODULES

6.1 Identify the filled dustbins.
6.2 Indication to the system.
6.3 Communication through IoT framework.

6.1 Identify the filled dustbins:

Here, the bins are deployed with sensors and are networked together using WSN (Wireless Sensor Networks) to collect the waste from the bins. These Wireless Sensor Networks are wireless networks that usually consist of a great number of far distributed devices that are equipped with sensors (instruments that measure quantities in our environment) to monitor physical or environmental phenomenon's.So that, we can identify the filled dustbin using this WSN.

6.2 Indication to the system:

Here, by using the sensors ingarbages, the user will get an indication through mobile or pc whenever a particular level is filled in garbage collector.

6.3 Communication through IoT framework:

Here, by using IoT, we can get the information that if particular bin is filled, how much level of the bin is empty in a pc or in a mobile. So that, we can collect the waste from the bins.

VII. Results and Discussion

This section discusses about the simulation results of the proposed smart waste management.

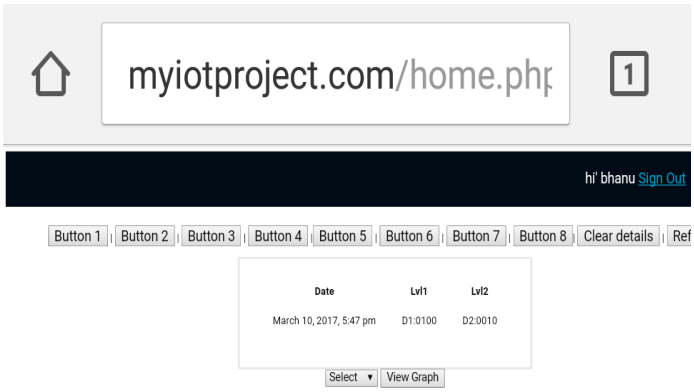

Fig. 3. Sample output of smart waste management using WSN and IoT

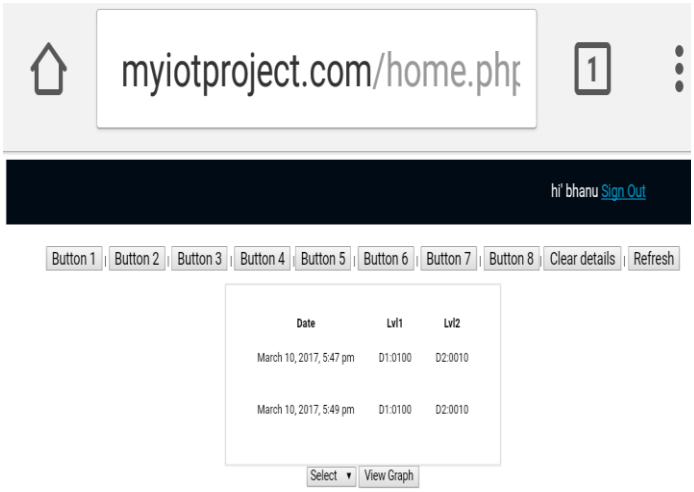

Fig. 4.Sample output of smart waste management using WSN and IoT

The above figures (fig.3, fig.4) shows the sample output when the wastage reached to the particular level of the bin using IoT(Internet of Things) . Here, bin1 is empty i.e. there is no wastage so, it shows 100% empty. And bin2 has wastage so it shows only 10% of the bin is empty. In addition, it also displays date and time when we receive the indication.

VIII. Conclusion

Hence, we tend to conclude that, by implementing this project we will determine the stuffed up dustbins and give indication to the GCV(Garbage Collector Vehicle). And so, it does not produce any user inconvenience caused by advanced discharge method and odor nuisance.

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