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SURVEY PAPER ON MUNICIPAL SOLID LIQUID BASED SMART WASTE MANAGEMENT SYSTEM- ZERO WASTE USING INTERNET OF THING

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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.

Keywords: Solid Waste Management, Garbage, Municipal Corporation, Internet of Things, Wifi, Zero Waste.

I. INRTODUCTION

For thousands of years, analysis of the physical environment is something that humanity has been doing that includes variety of parameters such as measuring distance, time, temperature, etc.

The communication and exchange of information in IoT, takes places to serve advances intelligent services to the users. With various sensors and communication technologies integrated together in the recent development in mobile devices has resulted in the rise of academic interests.

There is a critical need for a flexible layered architecture as the IoT should be cable of interconnecting billions or trillions of heterogeneous objects through the Internet. There are number of proposed architectures, amongst which the basic model is a 3 layer architecture, which consists of the Application, Network and Perception layer. However in the recent literature some other models have been proposed adding more abstraction to the IoT architecture. Among them simple architecture is illustrated in the figure below.

Figure 1: Architecture Of An Iot

Waste management has become a significant issue in academics, industries and government because of the characteristics and merits of IoT application fields. An absence of proper waste disposal, inefficient waste management policies have resulted in serious environmental issues. Various Researches to handle these problems

have been conducted into waste management. This paper proposes an IoT-based garbage and waste bin(s) detection system composed of a number of garbage bins, sensing unit, Wi-Fi modules, and server.

II. LITERATURE SURVEY

The garbage management in cities has to be effectively and efficiently implemented. The various proposals were put forward and some of them already implemented. But it cannot be considered as an effective one. So a survey was done among different proposals and this survey paper includes survey among different methods for smart garbage management in cities using IoT.

In [1], Smart Garbage Management in Smart Cities using IoT proposed a method as follows. The level of garbage in the dustbins is detected with the help of ultrasonic sensors system, and communicated to the authorized control room through GSM system. Arduino microcontroller is used to interface the sensor system with GSM system. A GUI is also developed to monitor the desired information related to the garbage for different selected locations. This will help to manage the garbage collection efficiently. Level detector consists of IR sensors which is used todetect the level of the garbage in the dustbin. The output of level detector is given to microcontroller. Four IR sensors are used to indicate the different levels of the amount of the garbage collected in the dustbin which is placed in public area. When the dustbin is filled up to the highest level, the output of fourth IR receiver becomes active low. This output is given to microcontroller to send the message to the Control room via GSM module. At receiver, control room is present where all the activities are managing. At receiver, control room is present where all the activities are managing. This system assures the cleaning of dustbins soon when the garbage level reaches its maximum. If the dustbin is not cleaned in specific time, then the record is sent to the higher authority who can take appropriate action against the concerned contractor. This system also helps to monitor the fake reports and hence can reduce the corruption in the overall management system. This reduce the total number of trips of garbage collection vehicle and hence reduce the overall expenditure associated with the garbage collection. It ultimate helps to keep cleanness in the society. Therefore, the smart garbage management system makes the garbage collection more efficient.

In [2] , a dustbin is interfaced with microcontroller based system having IR wireless systems along with central system showing current status of garbage, on mobile web browser with html page by Wi-Fi. Hence the status will be updated on to the html page. There by to reduce human resources and efforts along with the enhancement of a smart city vision. Considering the need of modern technology, the smart garbage bin can expensive but considering the amount of dustbin needed in India, there for they used based sensors to reduce its cost and also make it efficient in applications. And at the sender side they used only a Wi-Fi module to send and receive data. But because of the use of weight sensor for detection of amount of garbage in dustbin. It will only detect the weight of waste; not how much level it is of. The message can be sent directly to the cleaning vehicle instead of the contractor's office. Thus garbage bins are managed.

In[3] , a Geographical Information System (GIS) transportation model for solid waste collection that elaborates plans for waste storage, collection and disposal has been proposed in [3] for the city of Asansol in India. An enhanced routing and scheduling waste collection model is proposed for the Eastern Finland, featuring the usage of a guided variable neighborhood thresholding metaheuristic. The aim of the research was to develop an optimal schedule for trucks on defined collection routes. The data from the bins are processed in the DSS and if it is correct it is sent to organizers of waste collection in this particular place and to the road police. The truck driver doesn't waste time for waiting, he/she goes to the next point and the route is dynamically recounted. When the problem is solved the system recounts the route for one of the available trucks and the waste from unlocked bin is collected. It is combined with dynamic routing algorithms to maximize the efficiency of waste collection.

In [4] ,it reviews the researches done on waste collection in developing countries from 2005 to 2011 and considers challenges for developing countries in waste collection sphere. The research focuses on determination the stakeholders actions/behavior and evaluation of influential factors defining their role in waste collection process. The models in the survey were tested on real data. Considering system approaches for solid waste collection in developing countries is presented. The research compares the history and the current practices, presented from 1960s to 2013. The output of the survey is drawing a conclusion that developing and implementing solid waste collection approaches in developing countries are of a great importance. The main issue is that waste collection does not include innovation that IoT can provide. Models do not use real time information of the waste collection, although some approaches use advanced scheduling and routing via exploiting modern ICT algorithms. Information about bins status was not considered as part of waste collection. All the reviewed surveys do not

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propose a model that will use IoT technology for Smart Cities, though they consider different approaches for waste collection.

In [5] , the paper proposed an advanced Decision Support System (DSS) for efficient waste collection in Smart Cities. The system incorporates a model for data sharing between truck drivers on real time in order to perform waste collection and dynamic route optimization. The system handles the case of ineffective waste collection in inaccessible areas within the Smart City. Surveillance cameras are incorporated for capturing the problematic areas and provide evidence to the authorities. The waste collection system aims to provide high quality of service to the citizens of a Smart City. System architecture aims to suit two main targets. First target is providing software as-a-service (SaaS) products for customers. Mainly, these customers are private companies that are involved in waste collection, owning waste trucks, organize work of drivers, get contracts from municipalities and pass wastes to recycling organizations or city dumps. Second main target is developing a system, which makes possible mutually beneficial communication between all the stakeholders involved in the chain of supplying goods and utilizing solid waste in smart city. This paper presented a novel cloud-based system for waste collection in smart cities. The system aims to provide services for different kind of stakeholders involved in this area - from city administrations to citizens. Still, the design focuses mostly on providing SaaS services to commercial waste management companies.

In [6] , Infrared sensor (IR sensor) is used which is a multipurpose sensor, which can detect the level of garbage. IR sensor emits the light, which is invisible to naked eye but the electronic components can detect it. It consists of IR transmitter and IR receiver. The output of IR sensor is acquired by The National Instruments myRIO-1900. It is an input output device which is portable and reconfigurable. USB acts as a connector between the NI myRIO-1900 and host computer. It has connectors A and B that acts as an expansion port and a connector C that act as a mini-system port, they carry the signals and these signals are distinguished by different connector names. Sensor senses level of the bin. The GUI gives the output of what level of garbage is filled. Sensor senses level of the bin. The graphical representation to access the output of the sensor is as shown below. It gives the output of what level of garbage is filled. When the level in a bin is reached the threshold, the LED placed at the location of the bin starts blinking. When the blinking LED is clicked, a display opens showing the location of the bin, status of the bin, data and time when the bin gets filled, mobile number and the text to send to the concerned person. But this system does not ensure whether garbage is cleaned or not and transportation cost is another issue.

In [7] , Kalsiwal Mansai proposed model of Garbage Management using Internet of Things for Smart Cities in organizing the garbage collection system of residential or commercial areas. 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 GSM module. Micro-controller is used to interface the sensor system with GSM system. A GUI is also developed to supervise the desired information related to the garbage for various selected locations. The main feature that differs from other systems is that MATLAB based GUI. In this system there is a requirement of master and slave units. Slave unit is placed in the garbage bin likely wise master unit is placed at the control room. Slave unit consists of Arduino Uno board which has Atmega328 IC, ultrasonic sensor and GSM module. The entire circuit is placed at top of the dustbin. In ultrasonic sensor, the trigger pulse is continuously sent in the dustbin and echo pulse reflects back to ultrasonic sensor. Ultrasonic sensor continuously checks the garbage level in dustbin. Once the level of garbage reaches to specified threshold values, ultrasonic sensor gives indication to Arduino Uno board and through GSM, SMS will be send to control room which will indicate that the ―Please inform the cleaner of specific floor as the dustbin of that floor is full‖. In master unit when the SMS is received at control room, it will indicate on GUI the percentage of approximate garbage collection of that floor and it will automatically inform the cleaner of that floor.

In [8] , Vishesh Kumar Kurrel assures the cleaning of dustbins soon when the garbage level reaches its maximum. In this management system IOT as the working in the field for networked radio-frequency identification (RFID), tracking the collection vehicle, Dustbin monitoring and other emerging sensing technologies. The IR sensor is act as level detector. The assures a low budget by changing all light traffic servers into Raspberry Pi. The sensor senses the content of the dustbin and sends the signals or the data to the ARM microcontroller then the microcontroller reads the data from the sensor and process the data received from sensor, and the same data will send to Dashboard section and this section send mail/message to respective Municipal / Government authority person or collection vehicle. If the dustbin is not cleaned in specific time, then the record is sent to the higher authority who can take appropriate action against the concerned contractor. This system also helps to monitor the fake reports and hence can reduce the corruption in the overall management system. This reduces the total number

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of trips of garbage collection vehicle and hence reduces the overall expenditure associated with the garbage collection.

In [9] , Once the garbage reaches the threshold level ultrasonic sensor will trigger the GSM modem which will continuously alert the required authority until the garbage in the dustbin is squashed. Once the dustbin is squashed, people can reuse the dustbin. At regular intervals dustbin will be squashed.in In this method, GSM 900A modem is used to send the messages. It consists of a GSM/GPRS modem with standard communication interfaces like RS-232 (Serial Port), USB, so that it can be easily connected to the other devices. The ultrasonic sensor is used to find the height of garbage filled at different intervals of time. They use three sensors at various heights like h/3, 2h/3 and h, where h is the height of the bin but to make it affordable and to achieve the same results, only one sensor is placed at surface level. This system has various features such as durability, affordability, prevention against damage and maintenance issues. But they require a more amount of machines and labours.

In [10], there are multiple dustbins located throughout the city or the Campus, these dustbins are provided with low cost embedded device which helps in tracking the level 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. The project module is divided into two parts Transmitter section and receiver section. Here in the transmitter section we are using 8051 microcontrollers, RF Transmitter and sensors these are attached to the dustbin. Where sensor is used to detect the level in the dustbin whether the dustbin is full or empty. The sensor senses the content of the dustbin and sends the signals or the data to the 8051 microcontroller, Power Supply +9V Battery power supply is given to the 8051 microcontroller to drive the system and the 8051 microcontroller reads the data from the sensor and process the data received from sensor, and the same data wirelessly transmitted to the Central system (Intel Galileo microcontroller) using RF Transmitted. RF Transmitter is to transmit the signal form 8051 microcontroller to the Intel Galileo microcontroller. Here RF Receiver is used to receive the data sent by RF transmitter to the Intel Galileo microcontroller. The Intel Galileo Gen2 Microcontroller is used to receive the data sent by the multiple transmitters and process the data and the same data transmitted to the Client i.e., Web Browser. But comparatively the number of components used is more such as 8051 microcontrollers, IR sensors that make an excessive cost and complex codes.
In [11], the ZigBee, GSM (Global System for Mobile Communication) and ARM7 is used to form the Integrated system to monitor the waste bins remotely. The sensors are placed in the common garbage bins placed at the public places. When the garbage reaches the level of the sensor, then that indication will be given to ARM 7 Controller. The controller will give indication to the driver of garbage collection truck as to which garbage bin is completely filled and needs urgent attention. ARM 7 will give indication by sending SMS using GSM technology.

In [12], they came to a point It is important to understand the societal concerns over the increased rate of resource consumption and waste production and therefore the policy makers have encouraged recycling and reuse strategies to reduce the demand for raw materials and to decrease the quantity of waste going to landfill.
In [13],it is being proposed in this paper that introduction of an integrated system combined with an integrated system of Radio Frequency Identification, Global Position System, General Packet Radio Service , Geographic Information System and web camera will solve the problem of solid waste They also analyzed the actual performance of the system.

In [14], this paper objective of the study was to determine the characterization of the waste and the current system of management activities. The paper highlights an overview of the current municipal solid waste management (MSWM) system of Municipality and it concludes with a few suggestions, which may be beneficial to the authorities to work towards further improvement of the current management systems.

In [15], the proposed system describes that the level of garbage in the dustbins is detected with the help of Sensor systems, and communicated to the authorized control room through GSM system. Microcontroller is used to interface the sensor system with GSM system. A GUI is also developed to monitor the desired information related to the garbage for different selected locations. This will help to manage the garbage collection efficiently
In [16], it describes the application of our model of “Smart Bin” in managing the waste collection system of an entire city. The network of sensors enabled smart bins connected through the cellular network generates a large amount of data, which is further analyzed and visualized at real time to gain insights about the status of waste around the city. This paper also aims at encouraging further research in the topic of waste management.

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In [17], P.R. Naregalkar et al. developed IoT Based Smart Garbage Monitoring System, in which dustbins are interfaced with microcontroller based system having Ultra sonic sensors with wireless systems. These wireless systems central system showing current status of garbage, on mobile web application with connected via Wi-Fi. This proposed system implemented using ultrasonic sensor (also known as transceivers when they both send and receive, also work on a principle similar to radar or sonar, which evaluate attributes of a target by interpreting the echoes from radio or sound waves respectively), microcontroller (AT89S52 was used and designed with static logic for operation down to zero frequency and supports two software selectable power saving modes) and Wi-Fi module (Espress if Systems' Smart Connectivity Platform is used, which provides a set of high performance, high integration wireless SOCs, designed for space and power constrained mobile platform designers).

III. CONCLUSION

This survey has been performed for collecting the details of smart garbage management methods and to find out effective methods which are useful for providing hygiene environment in cities. As the level of garbage in the bins crossed the threshold, it will be informed to the corresponding authority, if it was found ignored then the details will be forwarded to the higher authority to take necessary actions. Thus a hygiene and clean environment can be provided. This survey helps in identifying all possible smart garbage management methods that can be implemented to make city clean.

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