Smart Solid Waste Collection System Based on Internet of Things

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Abstract-- Solid waste makes an ever growing problem at local and as well as universal levels. The disposal of solid waste is polluting all the factors of environment at regional and global levels. The world is facing a great challenge due to increasing urbanization as there is rise in the amount of generated waste and littering due to high demand for food products and other essentials. The main problem is faced in the developing countries than in developed countries was the continuous flow of garbage in all places where public people move around to create the unhygienic conditions. It may invoke several contagious diseases among the nearby people. To avoid such situations and to improve the cleaning, 'smart waste management system using on IOT' is proposed. The waste in the dustbins is checked with the help of sensors used in the system, the smallest version, E- nose on a chip containing both the sensors and the processing components then information is sent to the required control room through GSM/GPRS system. RL78/G11 Microcontroller is used to communicate the sensor system with GSM system. An android application is been modeled to monitor the information related to the waste for different selected locations.

Keywords: solid waste collection, RL 78/G11 microcontroller, GSM, Sensor, E nose Sensor.

I. INTRODUCTION

Internet of Things (IOT) is latest emerging technology which has used different applications. The term encompasses everything connected to the internet, but it is increasingly being used to define objects that "talk" to each other. The internet of things is made up of devices from simple sensors to smart phones and other devices. By combining these connected devices with automated systems is possible to gather information [1], analyze it and create an action to someone with a particular task from a processor. The information shared using the real world application can be viewed from any place at any time.

Internet of things helps the cities to be improved by making the people use modern technologies for different kind of activities. With the help of hardware and software technologies all common things and infrastructures will integrated. The sensors will be placed in the road and all streets to measure the temperature, noise, traffic etc. to provide better service to peoples for monitoring the environment and react to the natural disasters quickly.

An efficient management of waste is a requirement for maintaining a clean and green environment as there is increase in all kinds of wastes thrown by many places like industrial, agricultural, home waste etc. waste can be recycled through various technologies. The municipal authorities is mainly on problems related to the collection

the waste from different locations, transporting them for degradation is manual which takes a lot of effort and is time consuming process. Due to improper disposal of waste in the environment many diseases are attracted due to the presence of many insects like flies, mosquitoes, rats and other pets. These cause diseases such as cholera, eye problems, skin diseases etc. The solid waste collection is very difficult in developing countries as there is no proper management system for collection of waste and recycling.

Huge amount of money is wasted every year for wastage collection from all cities. According to the population a number of bins are placed near to road and require a number of vehicles. The waste collection from bins is based on the material in the bins like plastic, raw, wet waste, dry waste and liquid waste. The dry waste is a light weighted waste and can be collected by three or four days with regard that there is no effect to the environment. Wet waste must be collected within two days without the regard of the state of the bin because the waste must be thrown before it starts smelling or overflowing wet waste which causes air pollution.

The air pollution is one such form that refers to the contamination of air. Air pollution can be classified into two sections that are visible air pollution and invisible air pollution. It occurs when any harmful gases, dust, smoke enters into the atmosphere and makes it difficult for humans, plants and animals to survive as the air becomes dirty. The

air pollution causes various respiratory diseases and other adverse health effects as contaminants like carbon dioxide, nitrous oxide, methane and etc are absorbed from lungs into other parts of the body. The wet waste release a methane gas that is directly responsible for greenhouse effect. This causes improperly collected and uncollected waste dumped in streets or in drains. In everyday life we found the polluted air especially through bad smell, which are usually caused by disintegrated and liquid waste items.

II.   RL 78/G11 microcontroller

RL 78/G11 microcontroller is new generation microcontroller combining advanced features from both 78K and R8C to deliver low power consumption and high performance. RL78 is designed specifically for ultra low power applications enabling customers to build compact and energy efficient system at low cost.
RL 78/G11 microcontroller is used as a base board for many kinds of sensor applications. RL 78/G11 microcontroller has a rich array of analogue features including ADC, DAC, comparator and programmable gain amplifier and Ultra low power with smart features such as the data transfer Controller etc.

III.   E-nose systems

The human nose has been used in many industries to measure the quality of food, drinks, perfumes and also cosmetic and chemical products. The solution to the human nose of sensing the associated analytical techniques is the electronic nose [2] (e-nose). E-nose systems sensors to response to a given odors, performs odors identification and discrimination.
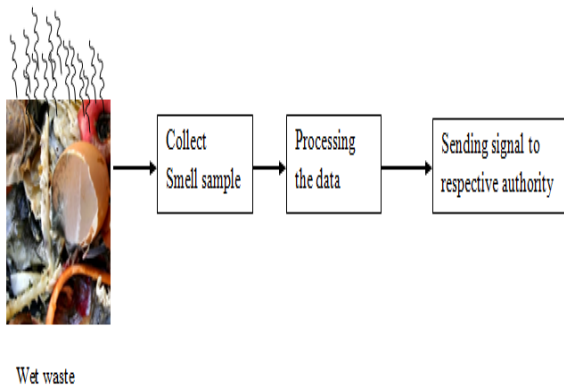

Figure 1: working of E-nose

1.   Working of electronic nose system
Electronic nose works on the mechanism as that of human smell sensors. When we breathe the volatile compounds suspended in surrounding atmosphere are accepted by our smell sensors. Human brain is a huge repository of many kind of diverse information from which different types of

odours also occupy their own space. When we smell, it is matched with those already present in our brain which let us identify the odour. In electronic nose, this task is performed by sensor arrays and pattern recognition system.

Electronic nose consists of three modules for achieving this: Sample Delivery System, Detection System and Computing System [3].

Figure 2: phases of e-nose

2.   Sample Delivery and Capturing Systems
Depending on the types of application involved, various types of systems have been developed and are used to deliver gas samples to the inside of the e-nose [4]. The main differences between the various systems relate to the type of sample requiring analysis, with regards to the electronic noses proposed for air quality monitoring ,a tube connected to a dedicated pump is generally used. In terms of electronic nose being used to monitor water quality, the air flow sent for analysis to the instrument is generally sampled from the headspace created in enclosed chamber in which the liquid to be analyzed is placed and into which odourless air is ducted. In the case of interstitial gas in soil or emissions from solid or emissions from solid heaps, specific foods or wind tunnels can be used in addition to the headspace method [5]. The gas mix attained at the outlet of these sampling systems can then be conveyed to the electronic nose detection system.

3.   Detection System
The sensor array and the nature of each individual sensor are the most important feature of any e-nose. The resilient compounds interact with the sensor surfaces and origin a change in certain chemical and physical properties of the latter. These deviations are then converted to an electronic signal which is sent to the data processing system. Disregarding of the type of sensors used and their working temperature, it is essential to keep the temperature and humidity levels of the sensor chamber as constant as possible. These parameters can be set to optimize both the absorption of the odour molecules and the successive description [6].

The number of types of sensors in an e-nose is generally selected on the basis of the specific applications. However, it is possible to recognize certain characteristics common to all sensors used in environmental field applications. First and foremost, the sensors have to be partially selective and

sensitive to the substance of interest furthermore their response has to be fast, stable, reproducible and reversible.

4. Sensor based monitoring of bin fullness status

The various liquids and gases takes the proper layers of filling so it is comparatively easier task to sense the level than to sense a level of solid waste materials. The different sensors which are weight, filling and smell sensors are placed sensed data from these two sensors will give status regarding with bin fullness. The weight sensor is at the bottom of dustbin where as filling sensor is at the top of the dustbin similarly smell sensor are placed at the middle of the dustbin [7]. Wireless networks will play role of conveying this status of respective dustbin to authorized persons system data base. The authorized person can pass the information to the respective vehicle driver to check the dustbin and replace with empty dustbin. This will avoid the overflow condition of a dustbin and ultimately its side effects like spreading number of diseases.

IV. Data Analysis for Electronic Noses

The electronic noses employ an array of chemical gas sensors and been widely used for the analysis of volatile organic compounds. The range from the food and medical industry to environmental monitoring and process control. Data analysis in e-nose technology is principally based on generating prediction models that need to be validated internally and externally for eventual use in environment. E-nose is device able to characterize and differentiate the odour profiles of various food products. During recent years e-nose have been widely used in food analysis and provide a fast, simple, non-expensive and non-destructive method of food assessment and quality control [7]. E-nose is analytical instruments designed to mimic the work of human sense of smell.

The analytic process doesn't focus on the identification and frequency of the components of the mixture of volatile compounds but rather on the significant description of the complete odour profile including the relationships between its components. The analysis is fast, simple and low-cost, what makes the e-nose a gratifying analytical method for quality control applications.

S.No	Bin id	Date &Time	Filling Level	Weight	Smell Level
1	461851	12/12/2018	46.48	7.3	40
2	198764	12/12/2018	48.56	8.4	50
3	498942	12/12/2018	56.21	10.2	32
4	156548	12/12/2018	49.79	9.6	26
5	156879	12/12/2018	58.11	11.5	25
6	356921	12/12/2018	36.25	6.1	80
7	254976	12/12/2018	20.89	4.2	45
8	956552	12/12/2018	65.28	14.0	60
9	648216	12/12/2018	75.2	15.1	13
10	468562	12/12/2018	33.65	6.6	30

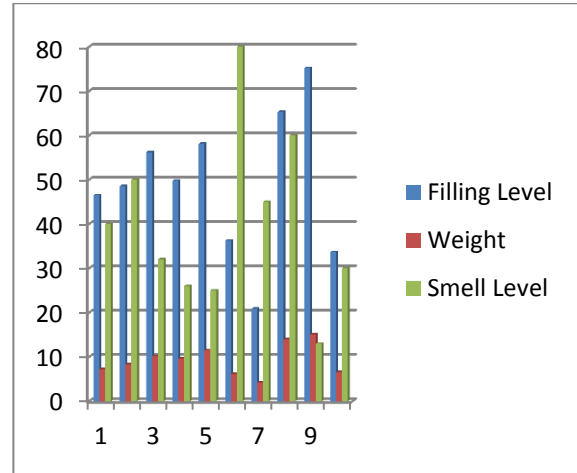Figure 3: Bin collection information

Figure 4: Analysis of bin information

The most interesting applications of electronic noses regard those fields where these instruments may provide information that is not overlapping with chemical analyses. This is typically the case of electronic nose used for odours detection. In the field of odour monitoring electronic nose might represent not just an alternative to chemical analysis

V. CONCLUSIONS

In the recent years it was demonstrated that electronic noses provide a fast, simple and non-destructive method of analysis. E-Nose was successfully employed mainly in the quality control to monitor spoilage or adulteration and the obtained results were in accordance with the sensory evaluation, offering a reliable tool for on-line analysis. The ability of e nose to determine the antioxidant status of food and other waste samples was also proved. The smart city is a newly emerging trend and actively running all over country. The proposed system is best suitable concept to implement and provides optimum solution for the major issue of managing solid waste properly in terms of collecting it and cleaning waste thrown in and outside the dustbin. The e-nose sensor placed at the middle of the dustbin and collects the smell samples, if the range of smell was greater than certain limit smell status to respective authority in Municipal Corporation. In future work by replacing e-nose to olfactory receptors (ORs) are responsible for the detection of odours which give rise to the sense of smell efficiently.

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