IOT Based Waste Management, Monitoring & Tracking – SMART BIN

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Abstract: In the recent decades, Urbanization has increased tremendously. At the same phase there is an increase in waste production. Waste management has been a crucial issue to be considered. This paper is a way to achieve this good cause. In this paper, smart bin is built on a microcontroller-based platform Arduino Mega board which is interfaced with GSM modem and Ultrasonic sensor. Now a day's Automatic systems are being preferred over manual system to make life simpler and easier in all aspects. The number of users of internet has grown so rapidly that it has become a necessary part of our daily life. Dust bins placed across cities set at open placesare flooding because of increment in the waste each day andmaking unhygienic condition for the citizens, we have proposedwaste management system for smart cities whichallows municipal corporations to monitor status of dustbinsremotely over web server and keep cities clean very efficiently byoptimizing cost and time required for it. As soon as dustbin hasreached its maximum level, waste management department getsalert via SMS via GSM module placed at dustbin, so department cansend waste collector vehicle to respective location to collectgarbage.

Keywords: Arduino Mega 2560, Ultrasonic Sensor, Load Cell, Wi-Fi Module, GSM Module.

I. INTRODUCTION

At present, most of the cities around the world require challenging solutions for solid waste management, as there is rapid growth in residential areas and the economy. Municipal authorities have inadequate resources for waste management institutions to effectively collect the waste generated. It becomes an excessive wastage of resources when bins are collected that are filled up partially. The IoT based garbage monitoring system is a very innovative system which will help to keep the environment and cities clean. This system monitors the garbage bins throughout the city and informs about the level of garbage collected in the garbage bins to a person in the administrative department. For number of times we have seen that the dustbins are being overflown with the waste materials and the concern person don't have any information about it within the time, due to which unsanitary conditions are formed in the surroundings environment and living area. Bad smell is out due to waste in dustbin at the same time. Also, the bad look of the city which leads to air and environmental pollution and to some harmful infections and diseases around the locality which is spreadable easily. There are number of unwanted manual checks of garbage bin's level by municipal corporations which is less effective and time consuming. Trucks are sent to empty the dustbins whether they are full or not. And the trucks need fuel which is costly. Several sensing methods have been integrated and have combined their verdicts that offer the detection of bin condition and its parameter measurement. Though results and developed algorithms are efficient for automatic bin status monitoring work lacks remote monitoring of bin. So, in this paper we have proposed system which can be deployed in general purpose dust bins placed at public places and which allows us to monitor its status remotely over web browser for efficient waste management.

Hence, smart dustbin is a system which can eradicate this problem or at least reduce it to the minimum level.

A)   OBJECTIVES OF THE PROJECT

•   To eradicate unhygienic condition, deadly diseases and to maintain public cleanliness.
•   To develop a smart intelligent garbage alert system for proper garbage management by giving an alert signal to the municipal web server for instant cleaning of dustbin.
•   To provide exact location of the garbage using Google map.
•   To notifies the cleaner when cleaning is required and generates optimized routes for cleaning.

- To monitor and analyses the waste generation by each locality under the municipality.

II. PROPOSED SYSTEM
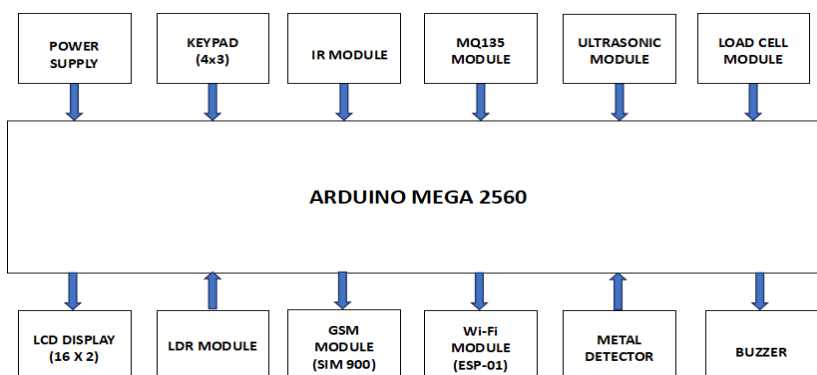
A) BLOCK DIAGRAM

Fig. 1 Block Diagram

B) PROPOSED METHODOLOGY

Things (inserted gadgets) that are associated with the Internet and occasionally these gadgets can be checked from the web are regularly called as IoT i.e. Internet of Things. In this framework dustbins are arranged at different locations. The Smart clean dustbins are related with the web to get the ongoing status. Ultrasonic sensors are settled at the highest point of the dustbin to avoid inaccurate level measurement and are interfaced with Arduino mega microcontroller. Weight sensor is placed at the base of the dustbin and is additionally interfaced with controller to recognize over weight of the junk filled in the dustbin. Both sensors send the signals to the controller. Ultrasonic sensor is used to check the level status of dust bin so to determine if it is full or empty, while Load cell senses the weight of the garbage present in the dustbin and to determine if the threshold limit is reached or not. Algorithm has developed which checks filled level continuously and if dustbin is filled to its maximum limit then there is indication on LCD display at the same time the encoded signal will be transferred to the internet. Active status of dustbin is shown on web page using connections through Wi-Fi module. Simplified flowchart of proposed system is shown in Fig. 2 Monitoring the webpage will help the garbage collection department to track for the exact location and amount of the garbage. The garbage vehicles can then unload the garbage from a particular location. The function of GSM module is to send a message to the garbage collectiondepartment. Metal detectors are used in the presented system to detect if there are any metal components present in any of the dustbins. The waterproof sensors are placed at particular level of the garbage bin which is connected to Arduino and ESP8266 Wi-Fi module. If once the garbage level reaches the particular height, then it will immediately process the information to the web-based software including the message as garbage is being filled by using Wi-Fi module. IR sensor is interfaced with Arduino for detecting the presence of waste outside the bin. The LDR Sensor Module is used to detect the presence of light / measuring the intensity of light. The output of the module goes high in the presence of light and it becomes low in the absence of light.The preeminent functions of LDR can be stated as follows : Primarily for providing street light in order to differentiate day and night and secondarily for favoring the prime priority to the bins that are filled up a bit previous than the others. The provided gas sensor is able to detect the foul smell outside the bin and thereby identifies presence of nearby waste surrounding the bin. It also helps in monitoring the air quality of the atmosphere where the bin is placed.
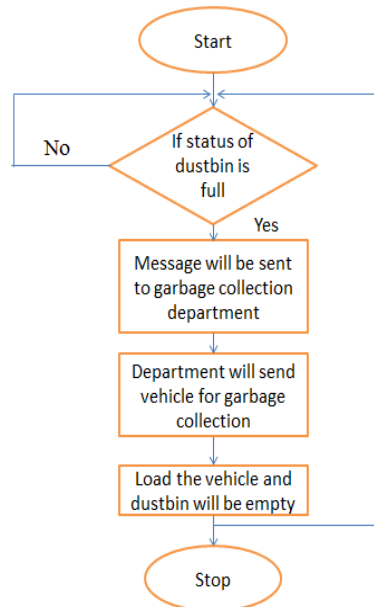
Fig. 2 Simplified Flow Chart of the Proposed System

C)   EXPERIMENTAL SETUP& IMPLEMENTATION

Using a set of carefully chosen sensors, we have implemented solid waste management system which is described previous sections. For the lab experiment, we have not considered the detailed manufacturing problems. Dust bin used for experiment is having cross section 12 X 12X 25cm, weight 380 gm and capacity of 2 litres. To avoid inaccurate and misleading level measurements we have installed ultrasonic sensor (HC-SR04) at the top of dust bin. Ultrasonic ranging module HC - SR04 provides 2cm - 450cm non-contact measurement function, the ranging accuracy can reach to 3mm. The modules include ultrasonic transmitters, receiver and control circuit. Using input trigger for at least 10us high level signal, the module automatically sends eight 40 kHz and detect whether there is a pulse signal back. If the signal back, through high level, time of high output duration is the time from sending ultrasonic to returning. On the other side load cell (HX711) is installed at bottom of dustbin. HX711 is straight bar load cell made up from an aluminium-alloy and has four strain gauges that are hooked up in a Wheatstone bridge formation. This straight bar load cell (sometimes called a strain gauge) can translate up to 20kg of pressure (force) into an electrical signal. Each load cell is able to measure the electrical resistance that changes in response to, and proportional of, the strain (e.g. pressure or force) applied to the bar. With this gauge you will be able to tell just how heavy an object is, if an object's weight changes over time, or if you simply need to sense the presence of an object by measuring strain or load applied to a surface.
We have also developed web page which allows us remote monitoring of the real time bin status. HTML code was written to design graphical user interface (GUI). After the cleaning driver verify the process by a password through the keypad.

III. RESULTS AND DISCUSSION

We have performed 10 test runs which completed 2 full cycles of loading and unloading of garbage. The empirical outcomes shown in data base table (1), whichrepresent the Bin ID, binfilling level based on the values for ultrasonic sensor placed at top of the bin, (ie, fil =1 represents 70% fil= 2 for 100% and fil=0%), weight of waste inside the bin and, value of gas sensor. value of the LDR sensor. Various possible combinations have been tested to assess performance of proposed prototype under different conditions. As shown in Fig. 3, if the bin is almost empty level shown by ultrasonic sensors is less than 1 cm for filling level and 0 kg weight by load cell. Gradually, we loaded bin with garbage and recorded readings for the same. At certain point when bin was fully filled no values were displayed byultrasonic sensor and load cell this is nothing but overload condition. For experimental purpose, the bin is unloaded only when it becomes overloaded.

IJIREEICE

International Journal of Innovative Research inElectrical, Electronics, Instrumentation and Control Engineering

NFTPCOS-18

National Conference on Future Technologies in Power Control and Communication Systems

College of Engineering Perumon, Kollam, Kerala

Vol. 1, Special Issue 2, March 2018

id	bin	fil	weight	ir	gas	st
1	KLM1515	0	0.0	66	546	0
2	KLM1515	1	5.10	501	50	100
3	KLM1515	2	15.00	49	510	667
4	KLM1515	0	0.000	45	450	632
5	KLM1551	0	0.000	45	451	633
6	KLM1551	1	10.00	45	450	632
7	KLM1551	2	18.00	222	554	715
8	KLM1551	2	0.000	58	493	0
9	KLM1551	2	0.000	235	506	0
10	KLM1551	2	-28.08₄	261	508	0

Fig. 3 Database which Shows Bin ID, Fill Status, Weight of the Waste inside the Bin, Sensor Values

We have also verified the status of bin over web page designed for remote monitoring of dustbins placed at different locations, home page is shown in Fig. 4. Web page provides information regarding location of dustbin placed, its status, name and last updated time. Real time status i.e. full or empty is shown on the web page. User can navigate to different bin locations from the home page.Web page shows the area location of dust bin and status i.e. whether it is full or empty, air quality, weight outside status of that respective bin which shown in Fig. 5. When the "MAP ICON" is clicked, it opens up to a new page showing the map location of the dust bin, which is shown in Fig. 6.Tapping the "GRAPH" button in the home page will land the user to the analysis page as shown in the Fig. 7. It displays a chart which shows the amount of waste collected by bins at different locations.
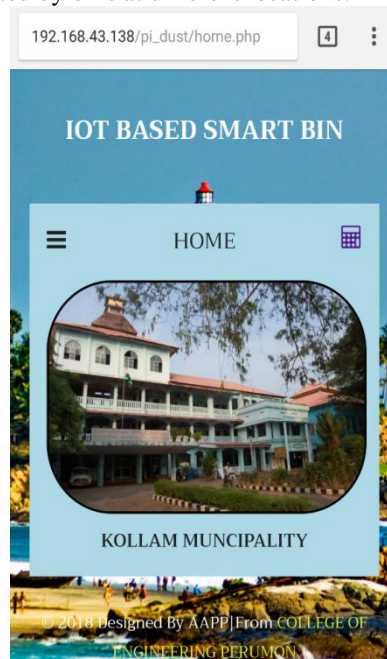
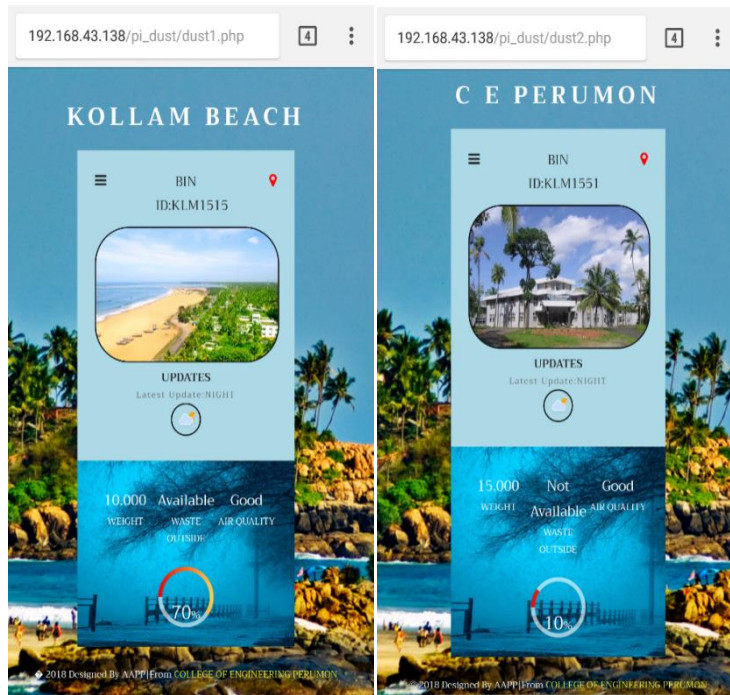Fig. 4Web HomePage for Remote Monitoring of the Real Time Bin Status
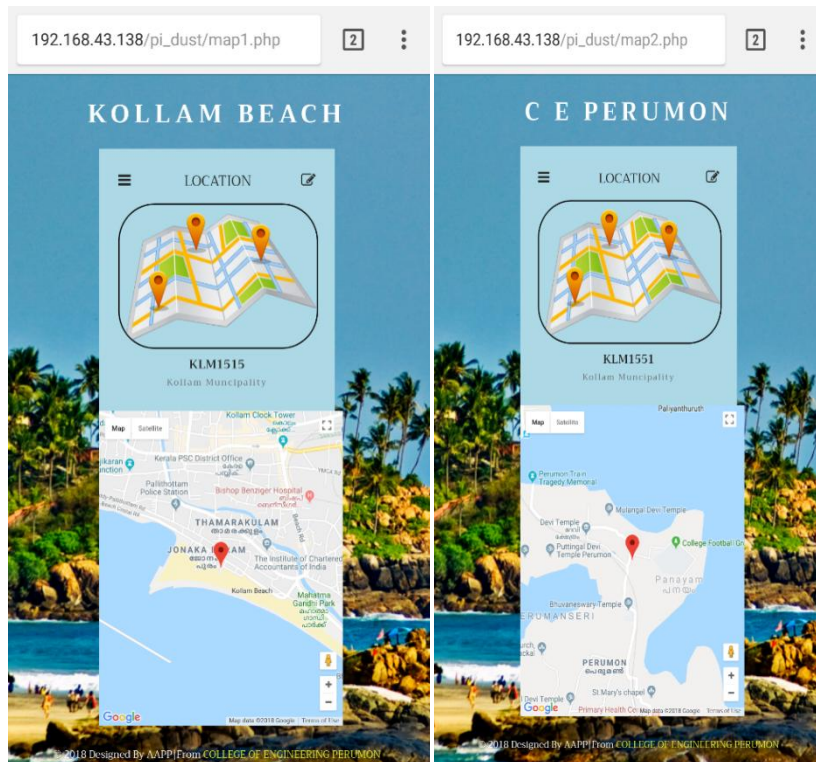
Fig. 5Real Time Status of Bins at Different Locations

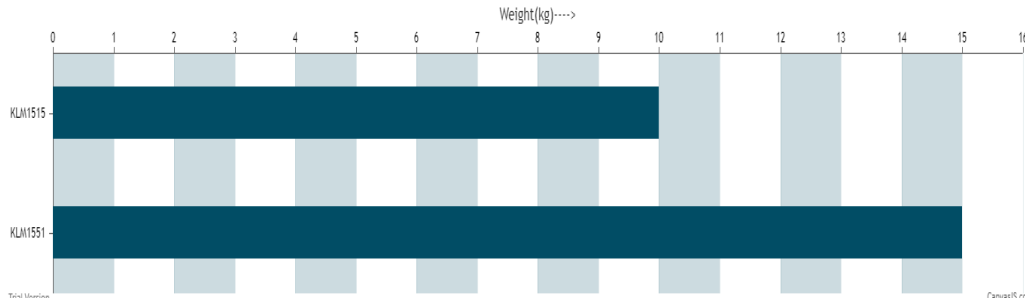Fig. 6 Google Map Location of Different Bins

GRAPHICAL ANALYSIS

Fig. 7 Graphical Analysis Based on the Comparison Result of Two Bins

Whenever the Dust bin fully filled, GSM modem is activated to send an alert message to the concerned person through an SMS. The SMS contain Google map link to the exact location of the bin. As soon as an SMS alert is received, concerned person can take necessary actions for cleaning the filled bins on time without allowing them to overflow. Fig. 8 shows the SMS alert for cleaner.
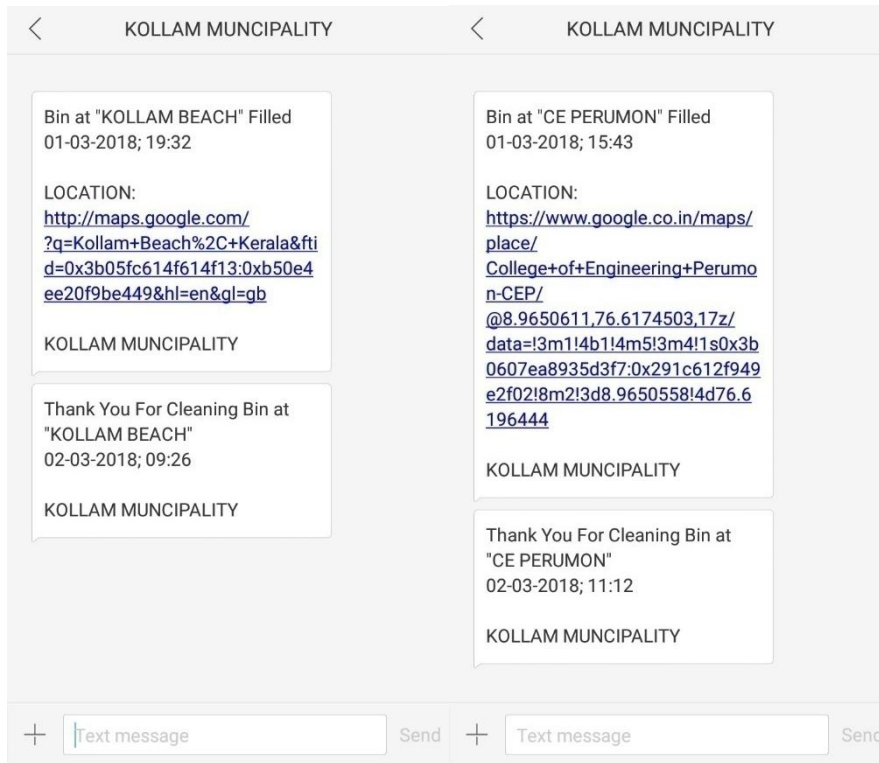
Fig. 8 SMS Alert for Cleaner from Different Bins

III. FUTURE SCOPE

- Additional sensors can be used to categories waste.
- An automated system can be developed which is able to pick up waste in and around the bin.
- Depending on the population coverage, its quantity as well as quantity can be improved.
- Proposed model can be extended to give free Wi-Fi access to the user when the dustbin is thrown inside.

IV. CONCLUSION

This paper gives basic idea about efficient garbage monitoring system by using the technology of IoT. By resource optimization, effective usage of smart dustbins can be done. This system indirectly reduces traffic in the city. The integrated sensing system is designed using ultrasonic sensor and load cell to offer a proficient and automatic dustbin status monitoring system. It also consists of Wi-Fi Module, Gas Sensor, LDR Sensor and IR Sensor. 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 of trips of garbage collection vehicle and hence reduces the overall expenditure associated with the garbage collection. It ultimately helps to keep cleanliness in the society. In addition to this it also aids to diminish the need for high human intervention in garbage maintenance of the municipality and pollution monitoring system. The overall system is cost effective, user friendly and it helps to reduce human resources, efforts and time consumption and hence helps in resource optimization.Also the system informs the status of each and every dustbin in real time located throughout the city so that the concerned authority can dispatch the garbage collection vehicle only when the dustbin is completely full or is about to full. But since the technology is new in India, proper awareness should be created among the public before it is implemented on a large scale. Otherwise, sensitive devices like sensors might be damaged due to rough action of the users. As the size of garbage bin size increases, the need of sensors will also increase.

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