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Smart Garbage Monitoring System using IoT

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ABSTRACT: *As the world's population is growing at a fast pace, more and more waste is produced daily and waste management becomes a more crucial matter and concern. Most important is the collection of solid waste from city garbage bins. Inadequate or inefficient collection processes lead to undesirable and in some cases unsanitary conditions that pose a health risk to the surrounding communities. Such risks are presented in the form of overfilled garbage bins and foul odors'. There is lack of planning, data on the collection, and poor infrastructure for the collection of waste and for the waste management. To provide solution to this Smart Garbage Monitoring System is proposed. The system will allow the authorities to better manage, plan, & utilize their resources for garbage collection also hygiene & cleanliness can be maintained.*

Keywords: Internet of Things (IoT), Smart Garbage Collection, Waste Management.

1. INTRODUCTION

With the popularity of the Internet of things (IoT) growing, and the availability of low cost actuators and sensors, the approached method aims to monitor the bin whether it is full or half filled or empty and proposed method[1] will calculate the sensor levels in bin and data will be sent to the mobile application second to second. The first sensor will measure the level of waste in the dustbin located all over the city in different locations. The data collected by the sensor is then sent to Arduino and to the cloud, the output data i.e. the level of dustbin is then showed in the application when the end user logs into the application [2]. A notification pops up in the application whenever a dustbin of a particular location is full. An E-Mail is also sent to the end user stating, the dustbin is full. The second sensor measures the distance of hand of the person whenever a person comes near the dustbin to throw waste. If the distance of hand from the dustbin is less than 40cm then the servo will open the lid of the dustbin and when the distance of hand is more than 40cm then the dustbin's lid will close or will remain closed.

II. LITERATURE SURVEY

[1]The paper highlights that the collection, transport and disposal of solid waste, which is a highly visible and important municipal service, involves a large expenditure but receives, scant attention. This problem is even more crucial for large cities in developing countries due to the hot weather. A constructive heuristic which takes into account the environmental aspect as well as the cost is proposed to solve the routing aspect of garbage collection. This is based on a look-ahead strategy which is enhanced by two additional mechanisms. Interesting results were obtained when tested on instances with and without the presence of the effect of the environment.

[2]This study aimed to determine whether the waste management systems, that are presently applied in affluent countries are appropriate solutions for waste management in less developed regions. For this purpose, three cities (Vienna, Damascus and Dhaka) which differ greatly in their gross domestic product and waste management were compared. The criteria for evaluation were economic parameters, and indicators as to whether the goals of waste management (protection of human health and the environment, the conservation of resources) were reached. Based on case studies, it was found that for regions spending 1–10 € capita–1 year–1 for waste management, the 'waste hierarchy' of prevention, recycling and disposal is not an appropriate strategy. In such regions, the improvement of disposal systems (complete collection, upgrading to sanitary land filling) is the most cost-effective method to reach the objectives of solid waste management. Concepts that are widely applied in developed countries such as incineration and mechanical waste treatment are not suitable methods to reach waste management goals in countries where people cannot spend more than 10 € per person for the collection, treatment and disposal of their waste. It is recommended that each region first determines its economic capacity for waste management and then designs its waste management system according to this capacity and the goals of waste management. [3] The paper highlights the improper management of municipal solid waste (MSW) which causes hazards to inhabitants. Various studies reveal that about 90% of MSW is disposed of unscientifically in open dumps and landfills, creating problems to public health and the environment. In the present study, an attempt has been made to provide a comprehensive review of the characteristics, generation, collection and transportation, disposal and treatment technologies of MSW practiced[3] in India. The study pertaining to MSWM for Indian cities has been carried out to evaluate the current status and identify the major problems. Various adopted treatment technologies for MSW are critically reviewed, along with their advantages and limitations.

Generally, MSW is disposed of in low-lying areas without taking any precautions or operational controls. Therefore, MSWM is one of the major environmental problems of Indian megacities. It involves activities associated with generation, storage, collection, transfer and transport, processing and disposal of solid wastes. But, in most cities, the MSWM system comprises only four activities, i.e., waste generation, collection, transportation, and disposal. The management of MSW requires proper infrastructure, maintenance and upgrade for all activities. In the present study, an attempt has been made to provide a comprehensive review of MSWM for Indian cities to evaluate the current status and identify the problems of MSWM. The study also aims at encouraging competent authorities/researchers to work towards the improvement of the present system through suggestions and recommendations. [4] The paper highlights that solid waste management is a challenge for the cities' authorities in developing countries mainly due to the increasing generation of waste, the burden posed on the municipal budget as a result of the high costs associated to its management, the lack of understanding over a diversity of factors that affect the different stages of waste management and linkages necessary to enable the entire handling system functioning. An analysis of literature on the work done and reported mainly in publications from 2005 to 2011, related to waste management in developing countries, showed that few articles give quantitative information. The analysis was conducted in two of the major scientific journals, Waste Management Journal and Waste Management and Research. The objective of this research was to determine the

stakeholders' action/behaviour that have a role in the waste management process and to analyze influential factors on the system, in more than thirty urban areas in 22 developing countries in 4 continents. A combination of methods was used in this study in order to assess the stakeholders and the factors influencing the performance of waste management in the cities. Data was collected from scientific literature, existing databases, observations made during visits to urban areas, structured interviews with relevant professionals, exercises provided to participants in workshops and a questionnaire applied to stakeholders. Descriptive and inferential statistic methods were used to draw conclusions. The outcomes of the research are a comprehensive list of stakeholders that are relevant in the waste management systems and a set of factors that reveal the most important causes for the systems' failure. The information provided is very useful when planning, changing or implementing waste management systems in cities. [5] This paper reviews the factors which differentiate policies for the development of smart cities, in an effort to provide a clear view of the strategic choices that come forth when mapping out such a strategy. The paper commences with a review and categorization of four strategic choices with a spatial reference, on the basis of the recent smart city literature and experience. The advantages and disadvantages of each strategic choice are presented. In the second part of the paper, the previous choices are illustrated through smart city strategy cases from all over the world. The third part of the paper includes recommendations for the development of smart cities based on the combined conclusions of the previous parts. The paper closes with a discussion of the insights that were provided and recommendations for future research areas. [6] The paper specifies that the rapid urbanization and population growth makes efficient management of municipal solid waste (MSW) a challenge to municipal authorities. Considering this, the current study appraised the MSW practices including waste generation, collection, transportation, disposal and treatment in Chandigarh. The strength of MSW management includes the involvement of various public-private stakeholders including the Municipal Corporation of Chandigarh (MCC)[6]. The city has door to door waste collection system for its transportation at collection-cum-transfer station (Sehaj Safai Kendra). From SSK (Sehaj Safai Kendra) MSW is transported to Refuse Derived Fuel (RDF) plant. RDF plant utilizes the combustible fraction of MSW but discard organic fraction, which is dumped at an open disposal site. If the total MSW from Chandigarh is diverted to RDF plant it could reduce 5451 tCO2 emission per year and has potential to earn carbon credits under Clean Development Mechanism (CDM). Further, based on system analysis approach the study proposes options for the improvement in current waste management practices in Chandigarh, which could also be adopted by other cities in developing world to reduce the adverse impact of MSW on environment and human health. [7] In the present day scenario, many times we see that the garbage bins or dust bin are placed at public placed in the cities are overflow due to increase in the waste every day. It creates unhygienic condition for the peoples and creates bad smell around the surroundings this leads in spreading some deadly diseases and human illness , to avoid such a attenuation we are planning to design "GSM based garbage monitoring system for smart cities" .In this proposed system there are multiple dustbins located throughout the city or the campus ,these dustbins are provided with low cost embedded device which helps in tracking level of garbage bins and an unique ID[7] will be provided for every dustbin in the city so that it is easy to identify which garbage bin is full. When the level reaches threshold limits, the device will transmit the level along with unique ID provided. These details can be

accessed by the concern authorities from their place with the help of GSM and an immediate action can be made to clean the dustbins.

III. PROBLEM STATEMENT

3.1 Existing System

- Common practice for the collection of waste is done by a fleet of trucks that service fixed routes.
- The collection may not always meet the needs of the community.
- The existing system has limitations and is time consuming.
- The traditional way of monitoring wastes in waste bins is a cumbersome process.

3.2 Proposed System

- Develop a device (Sensor Node) that can monitor the state of a garbage bin.
- Collect sensor data from each bin and display it on a mobile application.
- Provide route planning for the collection based on the fill level of bins.
- Develop a sensor which can open the dustbin cover when we place our hand near to the dustbin.

IV. METHODOLOGIES

4.1 Algorithm:

Step 1: Start

Step 2: Initialize Arduino, Ultrasonic Sensor, & ESP8266.

Step 3: Measure the distance of hand from the dustbin.

Step 4: i) If distance < 40 cm, then the lid of the dustbin gets opened, then go to Step 3.

ii) If distance > 40 cm, then the lid of the dustbin gets closed or remains closed.

Step 5: Measure the level of the Trash can.

Step 6: i.) If distance < 75 cm, indicates the Level as Full, then go to Step 5 else ii

ii.) If distance < 50 cm, indicates the Level as Half, then go to Step 5 else iii

iii.) If distance < 25 cm, indicates the Level as Empty then go to Step 7

Step 7: Send the level information to the control room

Step 8: Control room sends the message to the driver

Step 9: Driver loads the vehicle with the dustbin and thus it is emptied

Step 10: Stop

V. SYSTEM DESIGN

5.1 Block Diagram

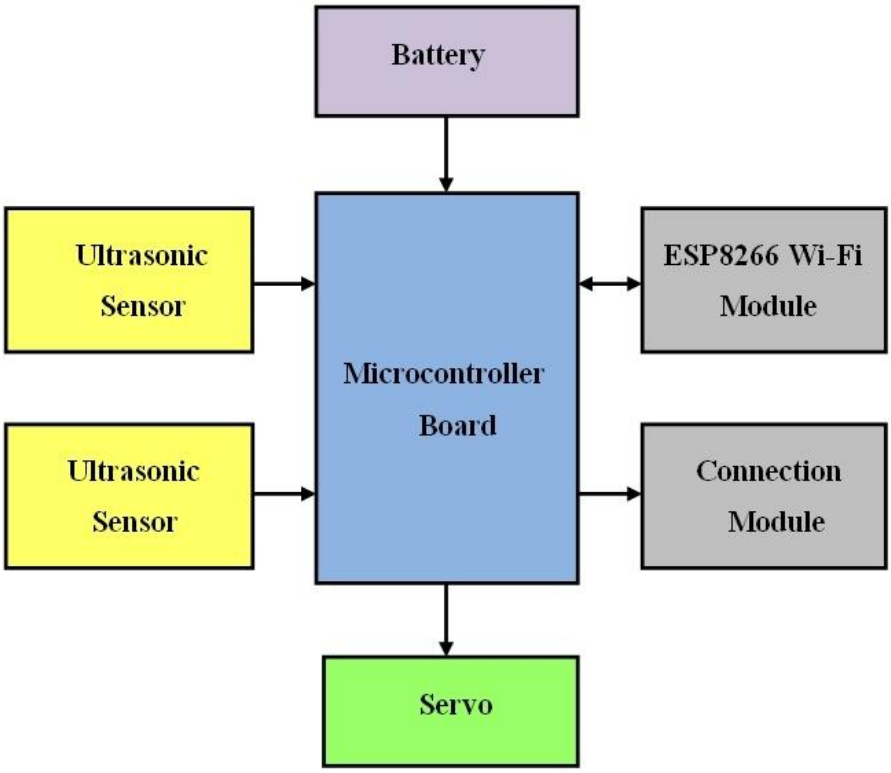

Fig 1: Block diagram

The fig 1 shows the Block Diagram for Smart Garbage Monitoring System. The purpose of each component is listed in the table below.

Table 1: Components Description

Components	**Operation**
Ultrasonic Sensor	Checks the fill level of bin
Ultrasonic Sensor	Checks the distance of hand
Microcontroller Board	Used to gather sensor data & transmit it to the mobile application
ESP8266 Wi-Fi Module	Provides wireless capability to the microcontroller
Connection Module	Provides the microcontroller with a connection to the mobile application
Battery	Provides power to the sensors, microcontroller board, ESP8266 & servo
Servo	Use to open & close the lid of the dustbin.

The components have to be fitted in all dustbins spread all around the city in different location.

5.2 System Architecture

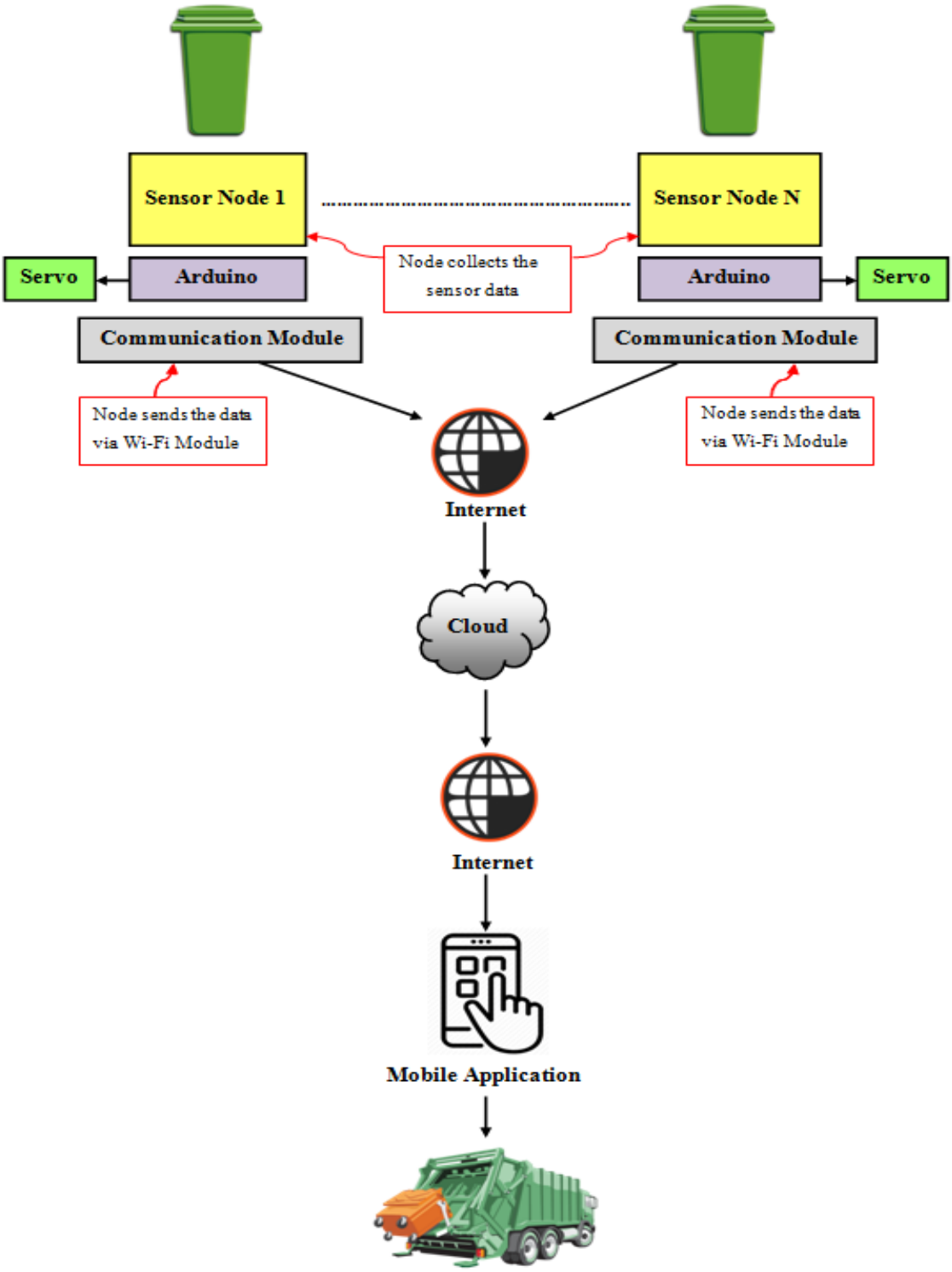

Fig 2: System Architecture

The above fig 2 shows the System Architecture of the Smart Garbage Monitoring System. Each of the sensor nodes performs entry into the cloud and directly receives any data back from the cloud. The information stored on the cloud is then made accessible via a mobile phone application. The independence of each of the nodes allows them to be placed without having to make any consideration on the other sensor nodes. The prototype was implemented and data uploads to the cloud from various locations were possible. The application also shows a pop up message whenever the dustbin is full & an E-Mail is also sent to the end user stating the dustbin is full. The notification & mail would intimidate the authorities so that they can take necessary actions.

VI. RESULTS AND DISCUSSIONS

The proposed system includes Blynk as the interface module. This Display the readings of respective sensors in the form of quantity levels to the end user. It shows that the dustbin is full, half or empty according to the fill level of the dustbin at a particular location. Additionally an alert message will be displayed on the application and a E-Mail will be sent to the end user when the dustbin is full.

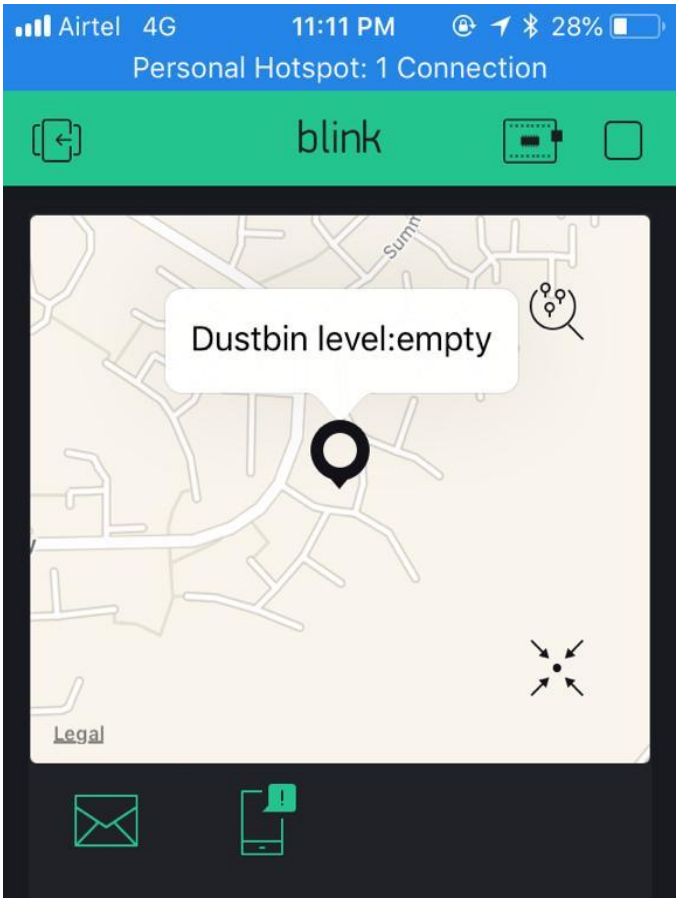

Fig 3: Dustbin level is empty being shown in app

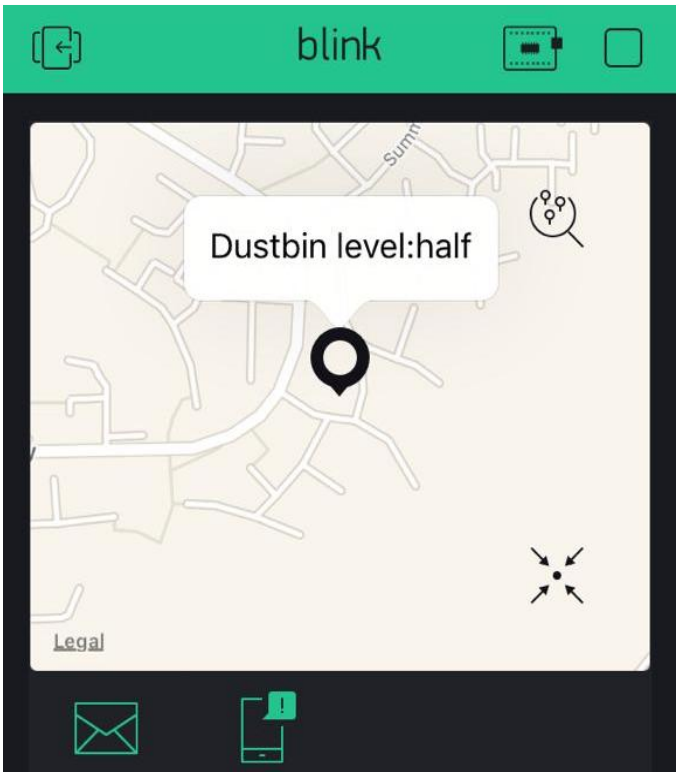

Fig 4: Dustbin level is half being shown in app

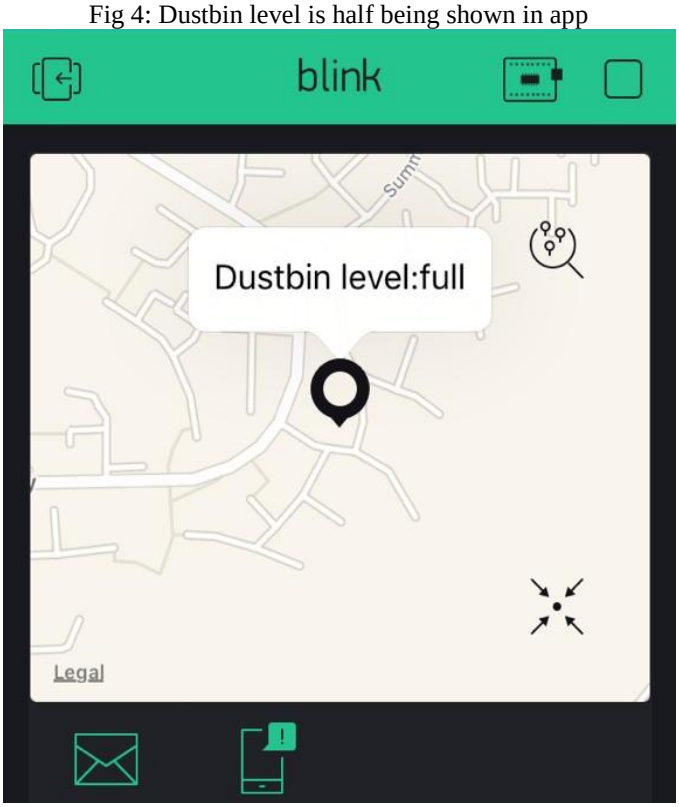

Fig 5: Dustbin level is full being shown in app

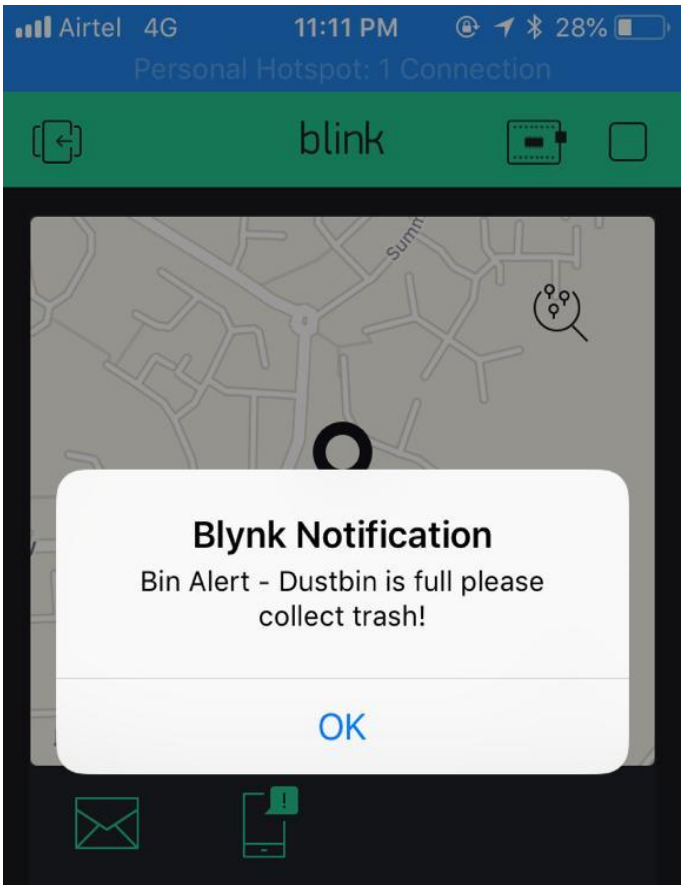

Fig 6: Dustbin is full notification being shown in app

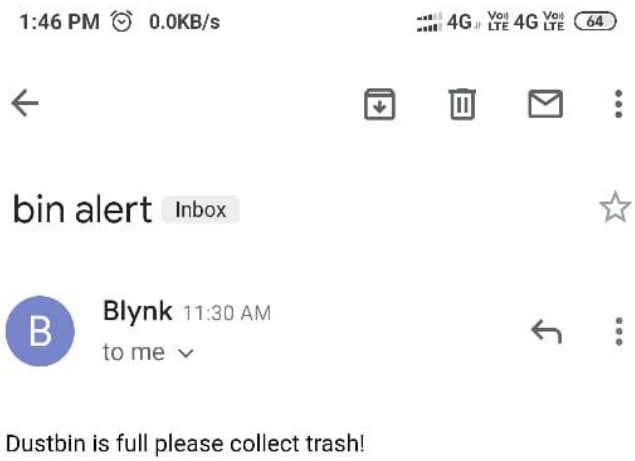

Fig 7: "Dustbin is full" alert E-Mail to the end user

VII. CONCLUSION

The main objective is to maintain cleanliness in the city and form an environment which is better for living. By using this system we can constantly check the fill level of the dustbins which are placed in various parts of the city. If a particular dustbin has reached the maximum level then the employees can be informed and they can immediately take certain actions to empty it as soon as possible. The employees can check the status of these dustbins anytime on their smart phones through the application. This can prove to be a very useful system if used properly. The system can be used as a benchmark by the people who are willing to take one step further for increasing the cleanliness in their respected areas. Ultrasonic sensor is being used in this system to check the fill level of the dustbins, but in future various other types of sensors can be used with the ultrasonic sensor to get more precise output & other kinds of data to take this system to another level. Now this system can be used in certain areas but as soon as it proves its credibility it can be used in all the big areas. As this system also reduces manual work certain changes can be done in the current system of garbage collection to take it to another level and make it more useful for the employees and people who are using it. Also by using servo and ultrasonic sensor which are used to open and close the lid of the dustbin when hand is placed near the dustbin, hygiene of the people & as a whole the hygiene of the society can be maintained.

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