Garbage Management System for Smart City

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***Abstract*—This paper introduces the garbage management system for maintaining hygienic conditions in a smart city. The key aspect of this system is to identify level of garbage in dustbin with sensor systems and alert the authorized control room through wireless module. An Android application will act as GUI to supervise the garbage status. GPS system employed will pinpoint the exact location of garbage bin. This system will avoid the regular monitoring of the bins and thereby reduce the operational time required.**

Keywords—Raspberry pi, Infrared (IR) Sensor, ARM Microcontroller, Wi-Fi module, Graphical User Interface (GUI), Global Positioning System (GPS), Smart City

I. INTRODUCTION

With increasing population in our country, urbanization has increased which has led to the generation of waste. Tonnes of trash are generated every year. Ten million tonnes of garbage is generated in the cities. This leads to deterioration of public health, environmental pollution, impact on quality of life of the citizens. Thus, waste management has been a crucial issue. The previous research in the area of technology related to Smart Garbage Management involves the use of Zigbee and GSM technology for connectivity. Earlier technology include RFID technology to identify tags attached to objects. A combination of above technologies have been used for connectivity purpose. There is shortfall in research to efficiently alert the authorities in an optimized way to maintain clean environment.

The system introduced uses more advanced wireless technology and handy applications for further improvements. The garbage full condition is automatically detected with the help of threshold value set and the information is transmitted to the concerned authorities to initiate the cleaning operations. The mechanism used to locate the bin helps in minimizing the time required for performing the cleaning process.

II. LITERATURE SURVEY

The previous research in the area of technology related to Smart Garbage Management involves the use of Zigbee and GSM technology for connectivity. Some also include RFID technology to identify tags attached to objects. While some others have used combination of the above technologies for connectivity purpose. Decision Support Systems (DSS) integrated with geographical information system (GIS) to optimize collection are used as Smart Trash System embodies an electronic device known as Smart Trash Bin, which consists of Sensors (Load sensor and IR proximity sensor) and a Radio Frequency (RF) transmitter. The sensors sense the waste status being collected by the Smart Trash Bin [3].

An automated GSM module, Load sensor, Microcontroller, DC motor, LCD, Web Camera and Power supply are the essentials for collection, monitoring and management of garbage. Implementation of this project helps in avoiding overflow of garbage from the container in residential area which is previously either loaded manually or with the help of loaders in traditional trucks. It reduces the productivity of the vehicles and manpower deployed and thereby helps in minimizing threat to the health of the sanitation workers as the waste is highly contaminated [1].

A combined integrated system of Zigbee and Global System for Mobile Communication (GSM) [5] is introduced. It helps in minimizing the usage of route, reduces the fuel cost, maintains clean environment. The objective is to design a System Based on Arm 7 for collecting the garbage from a particular area – the area whose public Garbage Bins are overflowing with prior concern. In this system, truck database has been developed in the way that information of truck ID, driver ID, date and time of waste collection, etc. are compiled and stored for monitoring and management activities. This system is able to monitor the solid waste collection process and management of the overall collection process. It provides on time solid waste collection.

The paper [6] concentrates on eradicating the issue of ignorance of cleanliness which is spoiling our environment and then reduce it. The smart trash consists of two sensors namely IR and gas sensors. The IR sensor placed inside the trash sense the level of trash and gas sensor will sense the toxic gases. Once the trash is filled, alarm rings. The RFID placed inside the trash will intimate about the overflowing of trash to the corporation office. The RFID placed at the corporation office is serial interfaced with PC.

The paper [4] proposes a smart bin application based on RFID system without requiring the support of an external information system and a method to improve the quality of selective sorting. This approach is based on local

interactions to track the waste flow of a city. Each waste is detected by information properties stored in a RFID tag associated to it. At each step where wastes are to be processed the RFID tags are read in order to provide the relevant information. This process improves the sorting quality of recyclable products. As organic wastes products are not recycled and hence RFID tags are not attached to it. In this way, undesirable wastes for a given container are either rejected or tracked, depending on the chosen policy for handling undesirable wastes.

The concept of integrated analytics and electronics is used in order to create optimal changes in the conventional methodology of waste collection with the large amount of data that is being produced by the smart bin networks which is further analyzed and visualized at real time to gain insights about the status of waste around the city. The product which is designed to make every dustbin smart is very handy using GSM integrated model, sensors and microcontroller. This product will not only help to stop overflow of dustbins along roadsides and localities ,but the cleaning time of smart bin will also be reduced using the prediction and route algorithm in a Real-Time monitor system which will smartly find the shortest route thus reducing the workforce [2].

An automatic garbage level detecting system [7] informing the concerned authorities timely and also classification among the wastes aiding efficient waste management. GSM is used in the project as a communication backbone for the whole system for various reasons like low cost, easy to implement and less signal deterioration. It is an automatic dust bin monitoring system in order to detect the full condition of the garbage bins. This provides the authorized users timely updates of the status of the garbage bins and thus eliminates the need of periodic manual checks and overflowing garbage bins.

There is shortfall in research related to these papers to efficiently alert the authorities in an optimized way to maintain clean environment.This research uses more advanced wireless technology and handy applications for further improvements.

III. METHODOLOGY

To resolve the problems of existing work we propose a new approach, that is, “Garbage Management System For Smart City”. This approach is extension work for the Zigbee, RFID and GSM-based waste management technology. The proposed work will solve the problems pertaining to bandwidth size, authorization, inaccuracy. This project work is the implementation of smart garbage management system using IR sensor, microcontroller and Wi-Fi module. This reduces the total number of trips of garbage collection vehicle and hence reduces the overall expenditure associated with the garbage collection. 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.

Fig. 1. Raspberry pi board

1) Raspberry pi:

Raspberry Pi is a low-cost, basic computer that was originally intended to help spur interest in computing among school-aged children. The Raspberry Pi is contained on a single circuit board and features ports for:

- HDMI
- USB 2.0
- Composite video
- Analog audio
- Power
- Internet
- SD Card.

The computer runs entirely on open-source software and gives students the ability to mix and match software according to the work they wish to do.

2) IR sensor:

An infrared sensor is an electronic instrument which is used to sense certain characteristics of its surroundings by either emitting and/or detecting infrared radiation. Infrared waves are not visible to the human eye. In the electromagnetic spectrum, infrared radiation can be found between the visible and microwave regions. The infrared waves typically have wavelengths between 0.75 and 1000µm. IR (infrared) sensors detect infrared light. The IR light is transformed into an electric current, and this is detected by a voltage or amperage detector. A property of light-emitting diodes (LEDs) is that they produce a certain wavelength of light when an electric current is applied but they also produce a current when they are subjected to the same wavelength light.

3) Wi-Fi module:

802.11b/g/n protocol, Wi-Fi Direct (P2P), soft-AP, Integrated TCP/IP protocol stack. Wi-Fi Module helps us to send the details of the dustbin at the receiver side. Thus, the Wi-Fi module acts as a transmitter

4) ARM Microcontroller:

ARM is one of the widely used micro-controller family in embedded system application. ARM is a family of instruction set architectures for computer processors based on a reduced instruction set computing (RISC) architecture

developed by British company ARM Holdings. A RISC-based computer design approach means ARM processors require significantly fewer transistors than typical processors in average computers. This approach reduces costs, heat and power use. These are desirable traits for light, portable, battery-powered devices—including smartphones, laptops, tablet and notepad computers), and other embedded systems. A simpler design facilitates more efficient multi-core CPUs and higher core counts at lower cost, providing higher processing power and improved energy efficiency for servers and supercomputers. ARM microcontroller used to reads the data from the dustbin sensor and process the data received from dustbin sensor, and the same data send to the Central system.

5) Mobile Application:

Mobile phone is at the receiver side that gives regular update of the garbage level through an Android application installed in it. An Android application acts like a GUI. All programs running under a GUI use a consistent set of graphical elements so that once the user learns a particular interface, he or she can use all programs without learning additional or new commands. In our system, we are using Android application. This environment contains pushbuttons, toggle buttons, lists, menus, text boxes. GUI is used to display the different Parameters and information regarding the garbage and garbage collection viz. location of dustbin, status of the dustbin, date & time of garbage collection. This will help the garbage monitoring to keep a track of dustbin filled in exact location. Thus our application will help the garbage monitoring to keep a check or track on dustbin. It will help him taking accurate decision and avoid the overflow of dustbin and use the resources more efficiently.

6) Data Storage:

The storage of data for maintenance of records can be done with the help of Desktop which can be required for analysis purpose. The task of programming can be done effectively with the help of the same.

IV. BLOCK DIAGRAM

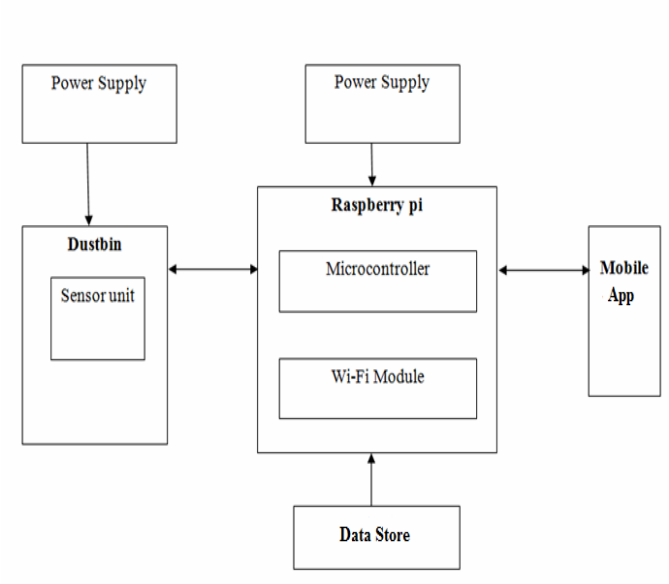

Fig. 2. Block Diagram

- The Sensor unit placed on the dustbin detects the garbage full condition accurately.
- The Raspberry pi comprises a microcontroller which receives the information from Sensor unit through WiFi module.
- The Microcontroller compares the input information with the threshold value set to send notification on Android application in mobile phone through the wireless network.
- The Power supply is mainly used to provide DC voltage to the components on board.

V. IMPLEMENTATION

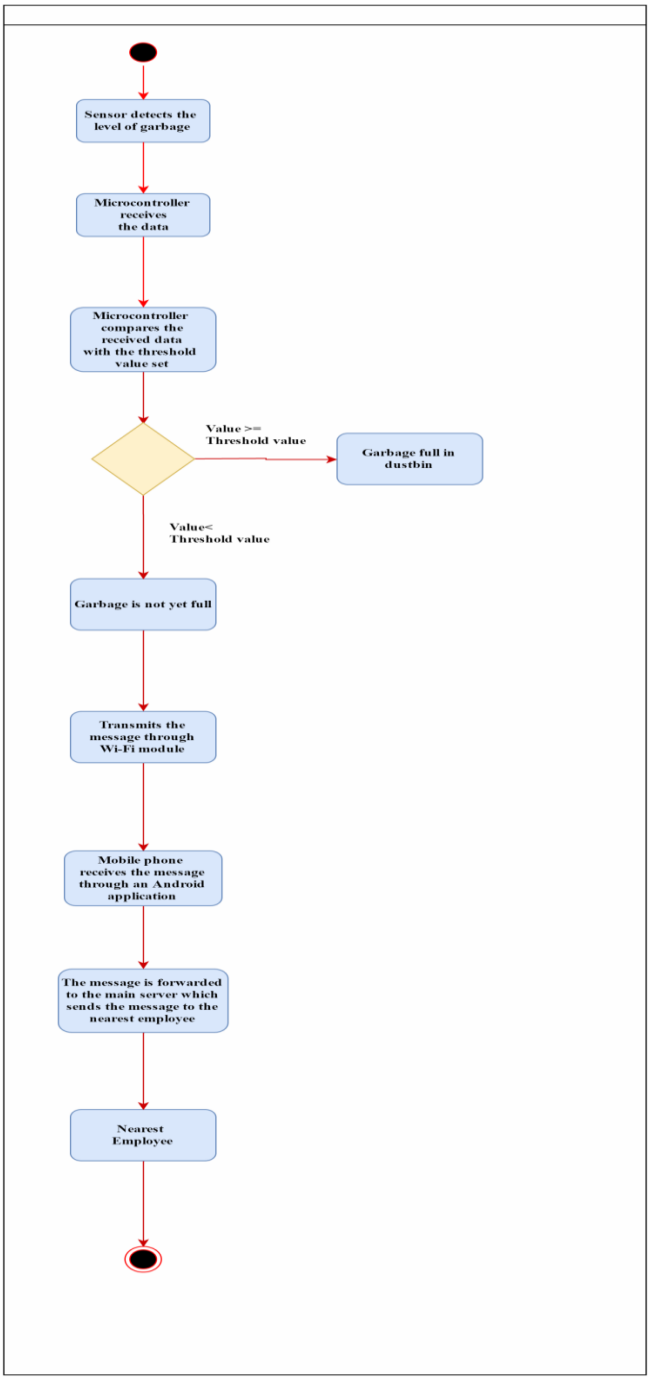

Fig. 3. Activity Diagram

The Fig. 3. represents the activity diagram for the "Garbage Management System for Smart City". Firstly, the sensor unit on the dustbin detects the level if garbage inside it. Accordingly, this data is received by the microcontroller. Microcontroller, then, compares the received data with the threshold value set in it. Comparatively, the message of garbage state is transmitted through the Wi-Fi module to the Mobile Phone that receives the message through an Android application. The message is forwarded to the Main Server which sends the message to the Nearest Employee.

VI. CONCLUSION

This paper proposes a system that makes sure that cleaning of garbage bins is done when level of garbage reaches its threshold value. The system uses IR Sensor, Microcontroller and Wi-Fi module. This further reduces operational time by alerting the concerned authorities via an Android application. This system also makes use of GPS technology in the Android application to alert the nearest employee and hence reducing the time for the dustbin cleaning process.

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