A Novel Approach for Effective Management of Municipal Waste Using IoT

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Abstract:
In our city many times we see that the garbage bins or dustbins placed in public places are overflowing. It creates unhygienic conditions for people which in turn lead to various hazards such as bad odour and ugliness to that place which may be the root cause for the spread of various diseases. To avoid this entire hazardous scenario and maintain public cleanliness and health, we are proposing a smart dust bin that operates automatically to solve this issue using IOT and sensor based circuitry and this work is mounted on a garbage system. Hence the main objective of this paper is to design a smart dustbin which will help in keeping our environment clean and also eco-friendly. The ultrasonic sensor, rain sensor, fall detection sensor and IR sensor is used to monitor the different status of dustbin like overflowing, spill out, positioning and rain water falling and intimate it to the municipal corporation. Municipal authority once they receive a message, they will take necessary action.

Keywords: Arduino UNO, Ultrasonic sensor, IoT, Servomotor.

1. INTRODUCTION
Now a day’s increase in population in turn increases garbage around urban areas. So dustbins are first step on any Waste management system. Here dustbins placed at public places are overflowing. So we need an early warning and a real time intimation system to the authorized person. The idea of new concept in IT world is keeping things internet of mutual. IOT has been an instrumental context in the development of smart cities. IOT gives the capacity to interconnect countless devices. United Nationals Conference on Human Settlement (UNCHS,(1996), says that a third to half the solid waste generated are disposed of in the streets, open space and drainage systems in low and middle income countries. In high income or developed countries, they follow effective waste management system. In existing system, dustbins are there in public places and wastes are cleared by authorised person weekly or monthly ones. But maximum dust bin are filled within few days and wastes e spread near to the dustbins which leads to bad odour occur in that particular place. The maximum dustbins are open type when rain falls; all wastes are mixed with rain water and spread into near housing areas which leads to spread of most of the diseases. This paper proposes an innovative system which will help to keep the cities clean. This system monitors the garbage bins and informs about the level of garbage collected in the garbage bins and the status of bin via android app. Municipal authority monitors the status of dustbin in real time through mobile. If there are any discrepancies, the authorities will take necessary action immediately.

2. LITERATURE SURVEY
[1] Waste management is one of the primary problem that the world faces irrespective of the case of developed or developing country. The key issue in the waste management is that the garbage bin at public places gets overflowed well in advance before the commencement of the next cleaning process. To avoid all such hazardous scenario and maintain public cleanliness and health, this work is mounted on a smart garbage system. The main idea of this work is to develop a smart intelligent garbage alert system for a proper garbage management. This process is aided by the ultrasonic sensor which is interfaced with Arduino UNO to check the level of garbage filled in the garbage bin and sends the alert to the municipal web server once if garbage is 90% filled via IoT. After cleaning the garbage bin, municipal web server gets updated about the garbage bin been cleaned. This system provides information regarding status of how waste collection is being done and followed up by the municipality authority (2017).

[2] Currently, most of waste management system is implemented using a conventional system. This paper presents a development of waste monitoring and collecting system based on Internet-of-Thing (IoT). The hardware implementation for the system consist of Node MCU (microcontroller board) connected to two ultrasonic sensors with Wifi module (ISM Band 900) attached to the board. In the system, these sensors are utilised to implement an automatic lid opener and to update the waste level condition for monitoring system. The developed system is designed to monitor the waste level (condition) in the bin (‘full bin’ or ‘not full’) via internet through mobile application (Apps). The developed App provides a real-time update of the waste level status for collection. In this project, the ultrasonic sensor sensitivity is tested on ‘flat’ and ‘non-flat’ waste type. The result showed that type of waste (‘flat’ or ‘non-flat’) with specific angle of reflection has influenced the sensor sensitivity to identify the waste level status. The developed system could be potentially utilised to improvise the conventional system waste collection to more effective system (2018).

[3] The uncollected waste material when the waste bin is full is a common problem nowadays. Thus, an efficient waste
management for the waste material is essential in ensuring a clean and green surrounding environment. This paper presents an Internet of Things (IoT) based Smart Waste Collection Monitoring and Alert System to monitor the waste material at the selected site of garbage collection area. The system is implemented using an ultrasonic sensor which is connected to Arduino UNO as to monitor waste bin garbage level. The store the collected waste bin level data into IoT database and display the waste bin depth level on online dashboard for real-time visualization. The Event manager invokes a notification alert to garbage collector mobile phone via a SMS when the waste bin is nearly filled for immediate waste collection. Therefore, the waste collection became more effective and systematic (2019).

[4] This paper entitled “Smart Bin for Waste Management System” plays a vital role in the waste management system. A healthy domain is essential to a solid and cheerful environment. Clean and hygienic environments are a key need in human habitable environments. Smart bin is to develop a gainful and dynamic waste administration framework. In public places, dustbins are being flooded just as the waste spills out bringing about contamination. This likewise expands number of infections as huge number of bugs to breed on it. In this a smart bin is developed to monitor the level of waste, automatic disposing of waste and rain detection system. The outcome demonstrated that the detecting framework is effective and can be utilized to robotize any solid waste bin management process (2019).

[5] Internet of things (IoT) is an emerging field which is increasingly becoming influential instrument in daily Moreover; it has increased the effectiveness of tasks by reducing the time span of the activity and augmenting its accuracy. It is being done with the help of internet service. IoT connects the activities with internet where it becomes easier to watch and monitor the process and the progress of the activity. Thus, IoT is making use of this dynamic feature of human innovation to add more innovative techniques to human lives. The focus of this research is to come up with a remedy for the problem of ever-increasing garbage. Here, an IoT based cost effective system has been developed. This system makes use of electronic devices and Thing Speak platform to minimize the expenditures and time duration in the collection and transportation of the waste. This concept is unique in itself as it makes garbage bins able to communicate their status, periodically, to the authorities. This data can be seen on internet and it is not bounded by any specific location as internet is a global phenomenon and so do the proposed system (2020).

[6] Smart waste collection is necessary step of smart waste management to smart our cities. Dustbins are the first step of any WMS (Waste management system). To make smart waste management system we should have smart Dustbins. The IoT has involved in entire areas of humanoid, exertion, strength as well as the social area, which significantly affect the possible development of the global financial community. The emerging technology of Internet of things can be use to improve our waste collection system. In this paper, we are proposing a smart waste bin to make the smart waste collection system. The smart bin contains a group of sensor that collects all the data from Bin for real-time status of Bin. This will result in effective waste collection, reducing pollution, reducing health threats and carbon (2020).

3. PROPOSED METHOD
The proposed method is to implement a prototype model of a smart waste management system. While implementation, IOT is used for automatic communication between bin and Municipal authorities to take remedial action as early as possible.

3.1 BLOCK DIAGRAM OF SMART WASTE MANAGEMENT SYSTEM

In block diagram power supply circuit supplies the necessary power required for Arduino UNO. Ultrasonic sensor is used to monitor the waste level in dustbin and if the waste reaches maximum level in dustbin automatically closes the smart bin by using servo motor and if the waste reaches 75%, automatically information is sent to the authorized person. Rain sensor detects the rain in order to avoid the spreading of sewage on roads and living places. If it rains, the smart bin closes automatically by using a servo motor and LCD is used to view the updates of the smart bin.

![Figure 1. Block Diagram of smart waste management system](http://ijesc.org/)

3.2 FLOW CHART:

Sensor in the bin monitors the different status of bin. If IR sensor detects waste, servo motor rotated to the 180 degree and closes the dustbin lid and sends this status to the required person through IOT. If there is any change in other sensor status, servomotor operates to close the door, alert message sent to authorities, buzzer sounds and the condition will be displayed in LCD.
3.3 COMPONENTS USED:

3.3.1. ARDUINO UNO

Arduino is an open-source gadgets platform. Arduino is a tool for the design and development of embedded computer system. Consisting of a simple open hardware design for single board microcontroller, Arduino UNO is a major part. Sensor outputs are connected to this board. The Arduino UNO is programmed using the Arduino Software (IDE). The board is equipped with sets of digital and analog input and output pins that may be interfaced to various expansion boards and other circuits.

![Figure 3. Arduino UNO](image)

3.3.2. SERVOMOTOR

A Servomotor is a rotary actuator or linear actuator that allows for precise control of angular or linear position, velocity and acceleration. It consists of a suitable motor coupled to a sensor for position feedback. It is used for door open and close process and mainly used for automatically sucking the garbage which lies outside the bin.

![Figure 4. Servo motor](image)

3.3.3. IR SENSOR

An infrared sensor is an electronic device that measures and detects infrared radiation in its surrounding environment, which releases to identify a couple of parts of the earth. When an object comes close to the sensor, the infrared light from the LED reflects off of the object and is detected by the receiver. These sorts of sensors gauge simply infrared radiation, rather than transmitting it that is called as an inert IR sensor. Everything transmit a type of warm radiations in the infrared range. A sensor converts stimuli such as heat, light sound and motion into electrical signals. The creator is an IR LED (Light Emitting Diode) and the locator is an IR photodiode which is shaky to IR light of a similar wavelength transmitted by the IR LED.

![Figure 5. IR Sensor](image)

3.3.4. FALL DETECTION SENSOR

When tilt is applied to the sensor, the suspended mass creates a difference in electric potential which is measured as a change potential which is measured as a change in capacitance. This system uses accelerometers, a type of low power radio wave technology sensor. To monitor the movements of the user. It can automatically detect a change in acceleration brought about by a fall. The fall alert detectors can measure when the user has suddenly fallen by detecting the abrupt changes of body movements.

![Figure 6. Fall Detection Sensor](image)

3.3.5. RAIN SENSOR

The Rain sensor module is a straightforward gadget. It tends to be utilized as a switch when raindrop falls through the rain sensing board it goes about as a switch and measures precipitation force. It detects water that completes the circuits. Its operating voltage is 5v and adjustable sensitivity. In this paper, it senses the water droplets and closes the bin lid thereby preventing the rain water falling inside the bin.

![Figure 7. Rain Sensor](image)

3.3.6. ULTRASONIC SENSOR

Ultrasonic sensor works on the principle similar to sonar which evaluates distance of a target by interpreting the echoes from ultrasonic sound waves. The sensor transmits an ultrasonic wave and produces an output pulse that corresponds to the time required for the burst echo to return to the sensor. By measuring the echo pulse width, the distance to target can be calculated. The maximum range of our products is presently 20 meters and varies by model. It has four pins, They are VCC, Gnd, Trigger and Echo. It uses a transducer to send receive ultrasonic pulses. It senses the level of garbage inside the bin.
3.3.7. LCD DISPLAY

A 16x2 LCD display is a module and is very commonly used in various devices and circuits. A 16x2 means it can display 16 characters per line and there are 2 such lines. A liquid crystal display (LCD) is an electronically modulated optical device shaped into a thin, flat panel made up of any number of color or monochrome pixels filled with liquid crystals and arrayed in front of a light source or reflector.

3.3.8. BUZZER

A buzzer is an audio signalling device operated from stepped down AC line voltage at 50 or 60 cycles. Here buzzer is used to alert the status of bin condition.

4. RESULTS & DISCUSSION

HARDWARE SETUP:

Figure 11 shows the hardware setup of smart waste management system and it’s working under various cases was given below

Case 1: Alert message to Municipal Corporation when garbage level reaches near to maximum level.

When garbage level reaches 75%, alert message will be given to Municipal Corporation and they will take necessary action.

Case 2: The bin lid gets closed when garbage bin is filled with 100% waste.

When garbage in bin get filled, bin lid get closed with the help of servomotor. The alert message will be given to municipal authorities and this condition is displayed in LCD.
Case 3: The Bin lid gets closed when it rains

Bin lid get closed when it rains with the help of servomotor in order to prevent odour. This condition was displayed in LCD.

Case 4: The bin lid gets closed when bin falls down.

When bin falls down alert message will be given to municipal authorities and its lid get closed with the help of servomotor.

Case 5: The bin sucks the waste which was around the bin.

The waste around the garbage bin was sensed by the IR sensor and it was sucked inside the bin with the help of 2 servomotors thereby maintaining cleanliness around the bin.

5. CONCLUSION

Garbage monitoring system using IOT enables an authority to check the status of dustbin without direct checking. This system enables us to monitor the amount of garbage filled inside the dustbin; garbage spilled outside the bin, the movement of bin and also detect the rain using a range of sensors. The controller gives an alarm and alert messages to the municipal authority to take remedial action and also operates servomotor to close the lid. This system helps the local municipal administration in waste management by monitoring domestic wastage and does clearance at proper time to avoid harm to the public health. This paper is a worthy elucidation for maintaining green environment and reducing several health hazards.

6. FUTURE SCOPE

In this work if garbage was spilled outside the bin servomotor automatically suck the spilled waste. If it is a large waste it is not possible to suck. Hence in future to avoid this circumstance, we will be updating our system by providing the dustbin for every house with RFID Tag. If dust bin was not used properly or garbage was thrown outside the bin it will be identified by municipal authorities and fine will be imposed to them.

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