

Smart Waste Monitoring System Using IoT

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Abstract- Waste management plays a major role in the country whose population grows exponentially. It is a systematic process consisting of collecting, transporting and disposing of garbage, sewage and other waste materials. One of the major problems in the current scenario is the unhealthy status of the dustbins. The monitoring can be done smartly by using the Internet of Things for transmission of the dustbin status. Arduino UNO is used to interface different sensors. The ultrasonic sensor is used to detect the user and automatically opens the dustbin lid. IR sensor will show the level of garbage filled in dustbin. Soil moisture sensor and IR sensor are used for segregating the dry and wet waste. Flame sensor is used for giving flame alert. The authority can get the status of the bin using Blynk app and notification is sent to both user and municipal authority when the dustbin is full.

Keywords- Waste management, Arduino UNO, Ultrasonic sensor, Soil moisture sensor, IR sensor, Flame sensor, Blynk app.

I. INTRODUCTION

Internet of Things (IoT) is a network for connecting the different things/objects. That's why it is also called as The Internet of Objects. The simple IoT application is connecting the different household appliances. The network usually consists of a microcontroller, sensors/actuators, and other components for enabling the different services as required for an application. This technology can be used to make smarter environment for the city. In most of the urban areas, waste management is a very important task to make the city cleaner, safer.

Waste management involves the activities, actions for managing waste from its initial stage to the final stage. The different stages include a process for collection, transport, treatment and disposal of waste, along with the monitoring. Waste can be solid, liquid or a gas. Each of the different type has the different methods of disposal and management.

The waste containers may overflow and can produce an unpleasant smell without proper management. An efficient waste collection can reduce the operational costs like fuel and manpower.

On 2 October 2014, the Government of India had launched the revolutionary Swachh Bharat Abhiyan (SBA). The core goal of this mission is to make the households and community areas of India clean & hygienic and improve the sanitation.

The waste getting generated is increasing day by day. The potential impact of the waste generated depends on the various factors such as industrial development, state of the environment, capacity. The situation is worsening in the developing economies. The reasons include waste

collection services being exhausted, inadequate management of dumpsites. Waste segregation is the first step in the waste monitoring system that helps to save the environment. This also improves the quality of the air in the atmosphere. Waste segregation is the process of separation of wet and dry waste. Usually the wastes getting generated are unavoidable and the materials in the waste impacts the overall human and environmental health.

Waste management has to be carried out by proper segregation of wet and dry waste. This can help in recycling the dry waste and wet waste can be composted. The items like aluminum foils, glass, paper etc are considered dry waste and stale food, fruits etc as wet wastes.

The main issue in the waste management is that the dustbins get full, well in advance before the cleaning process. So a system is required which can send the status of the dustbin to the concerned people, so that an appropriate action can be taken. If the bin is not full but the weight of the bin has reached the limit, the information is to be conveyed to the concerned for picking up of the wastes from the dustbin. The technology advancement can be made use of for proper waste management. The smart dustbin is one such solution to the waste management.

II. RELATED WORK

Mrs. Pallavi Nehete et al [1] discussed a system to avoid dustbins overloading. A GSM modem oriented smart dustbin is built, in which level detection is done by using IR sensor. Water sensor issued to detect the presence of water in wet garbage and provide an alert by using Buzzer in time to get to know that is wet garbage have been there in the dustbin. To display status of the dustbin, LCD is

used. If the garbage cross 70% of the dustbin level, GSM modem send message to particular person whose number is saved in SIM of the GSM modem. Buzzer is also used when garbage overflow at the same time when garbage overflows then message will be received by garbage collector.

In system [2], Miss. Megha S. et al implemented a smart garbage management system. A smart bin is built on a Raspberry pi Uno board with GSM modem and Ultrasonic sensor along with weight sensor. The weight Sensor is used for calculating the weight of the bin. The ultrasonic sensor is used for finding the status of the bin, the threshold limit is set as 10cm. When the junk achieves the limit level ultrasonic sensor will trigger the GSM modem which caution the required expert. The expert then sends the message to the separate administrators. 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.

According to the system [3], Aaditya Jain et al discussed a solution for the problems faced by the municipal authorities in which Microcontroller is used to take action based on the inputs provided by the output/actions of the sensors. Amount of waste in the dustbins is detected with Ultrasonic sensing. Force sensor is used to check the weight of the dust bin. PIR sensor is used to open the dustbin lid automatically if the bin is empty or partially filled. When the value exceeds the threshold value. An Android device helps in detecting the dustbin's location, updates the location and inform the respective vehicle to collect the waste. This information with GPS location is updated directly to Amazon cloud web server through GPRS.

In system [4], Dr.N.Sathishkumar B et al have developed 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 dustbin and sends the alert to the municipal web server once if garbage is filled. After cleaning the dustbin, the driver confirms the task of emptying the garbage with the aid of RFID Tag. The notification is sent to the android application using Wi-Fi module. In addition to this it also has facilitation to intimate the authority to clean up in case of any overflows. Programming in the Arduino UNO is done in such a way that once a particular level of filling is sensed information message is sent requesting a clean-up.

In [5], Murugaanadam et al developed a Smart Bin, in which an IR sensor is used for detecting objects and an ultra-sonic sensor is used for detecting the height filled in the bin. These Sensors are connected to the SPI Interface of the Arduino, and a buzzer is added with relays. Buzzer is used as an alarm in case people throw wastes around

the bin. A Sensor node is installed in every Smart-bin with a power supply unit. The Sensor node senses bin fullness, reports readings and Sensor statuses by using Ethernet modem from Arduino UNO. It also has a function to locks the bin door when it is full and also at rainy period. HTML based webpage is used to get the status in the office. Rain Sensors are connected to detect rainfall, to avoid entering of rain water into the bin. If any object is placed closer to the bin, the buzzer will be turned ON to give an alert to the user and update the status. Relays and Motors are used to close the door automatically when it receives bin full indication of ultrasonic Sensor and rain or water detection by rain Sensor.

In the system [6] by Harnani Hassan et al has provided a better waste management solution by using ESP8266, along with other sensors. The ultrasonic sensor is responsible to notify the waste level status inside the bin and update the status as data input to Wifi module via mobile Apps notification. The database is used to store the worker's information and bin data. The collecting system utilized the mobile app to identify specific bin for waste collection.

In the system [7] Sahil Mirchandani et al has proposed the IOT enabled dustbins which comprises of three sensors. These include RFID reader to read the user's RFID card, ultrasonic sensor as a level indicator and Air Quality Breakout Sensor.SIM808 for sending messages and establishing a communication between server and the dustbins, for the purpose of data transfer. An Arduino Uno r3 is a microcontroller board, used to read the values from all the sensors and send the data to the server. The system comprises of data processing unit with algorithms to decide which bins should be updated in the list for the collection on the basis of data received. Then, the algorithm computes the total weight from the list, and accordingly the number of the trucks and type of the trucks will be selected. The system also has an application unit consists of two android applications one for the user where the users are rewarded with points every time they scan the RFID card. And another to the municipal authority for location of the dustbin and find the fastest route to the dustbins.

III. SYSTEM DESIGN AND IMPLEMENTATION

The microcontroller, Arduino UNO is used. It forms the control unit of the entire project implementation. The microcontroller is embedded with a program that helps the microcontroller to take action based on the inputs provided by the output/actions of the sensors. The Arduino is connected to laptop for power supply. The sensors such as ultrasonic, Soil Moisture, IR, Flame sensors are connected to Arduino. The dustbin status can be displayed on the Blynk App. The application also has a

provision to notify the user regarding the status of the system even when the mobile device is locked.

1. Block diagram

2.

The Figure 1 refers to the block diagram of the system. It describes about all the hardware devices used in the waste monitoring system.

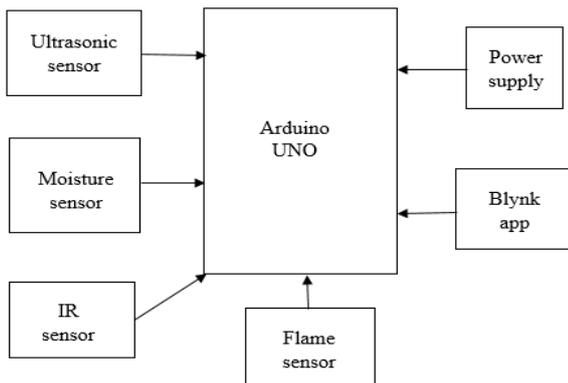


Fig.1 Block diagram of the system.

The following table gives the information about the components and its use.

Table I: Components and its uses

COMPONENT	USE
Ultrasonic sensor	Object detection
Servo motor	Opening of lid
Servo motor	Segregation of waste
IR sensor	Waste detection
IR sensor	Level detection of dry bin
IR sensor	Level detection of wet bin
Soil Moisture sensor	Moisture detection
Flame sensor	Flame detection
Buzzer	Flame alert

2. Algorithm

Step 1: Initialization

Step 2: Check whether user is detected

If user detected open the lid

Else remain in close position

Step 3: Check whether dustbin is full or not

If it is full then display in Blynk app and send message, dustbin is full.

Step 4: Check whether waste is wet or dry

If it is dry then waste is dumped in the right of the bin.

Else waste is dumped in the left side of the bin.

Step 5: Check whether there is presence of flame

If flame is detected then alert using buzzer.

Else don't alert.

Step 6: End

3. Flow chart

Fig 2 shows the flowchart of the system. First it will detect the User, if detected it will open the lid, otherwise lid will remain in closed state. It will detect the type of the waste if the waste is dry it is placed in right side of the bin or else it places in left side of the bin. If the level is less than 1/3 of the bin length it will show that the bin is full on the Blynk App. Then whether the waste has caught fire is checked if it has caught fire then it alerts using buzzer.

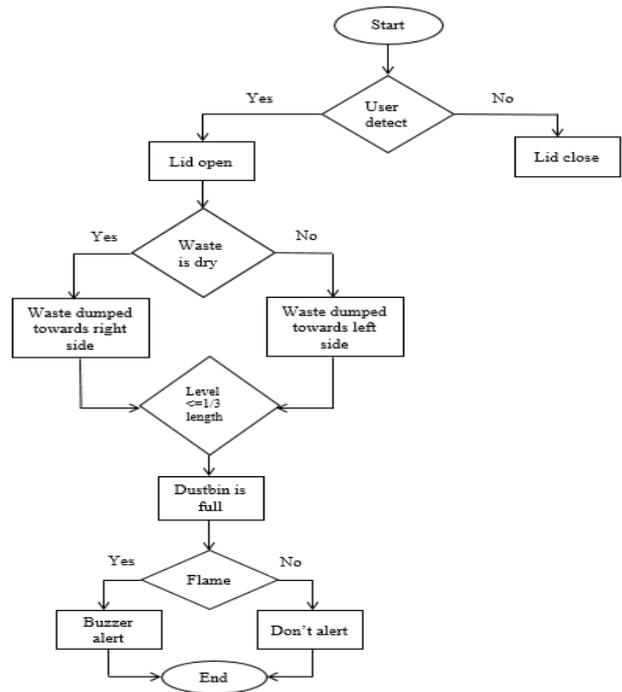


Fig.2 Flowchart of the system.

4. Circuit design

Fig 3 shows the circuit design of the system. Various sensors such as ultrasonic, IR, Flame, Soil moisture sensors and servo motor are connected to breadboard which are in turn connected to Arduino UNO Board.

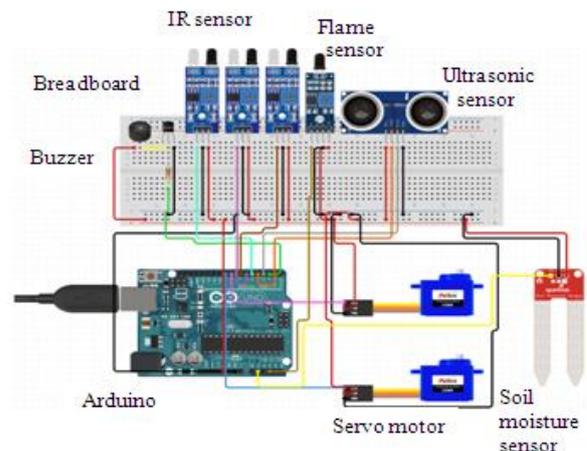


Fig.3 Circuit design of the system.

IV. RESULTS

The system is built using cardboard, for real time application dustbin can be used. Fig 4 shows the implemented dustbin where a ultrasonic sensor and buzzer are shown. Ultrasonic sensor detects the user and opens the lid. Buzzer will alert when flame is detected in the waste.



Fig.4 Implemented dustbin.

Fig.5 Shows the Front View of the System, in which the lid of the bin is opened which shows that the user has been detected. Ultrasonic Sensor and Servo motor is used to perform this task. Ultrasonic Sensor helps in detecting user and Servo motor helps in opening the lid.

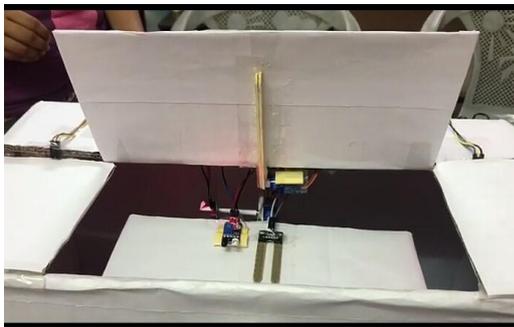


Fig.5 Front view of the system.

Fig.6 Shows the Top View of the System, which consist of the segregation lid which is used to separate dry and wet waste. With the help of servo motor, Soil Moisture and IR Sensor the waste is separated. Dry waste is dumped towards right side and wet is dumped towards left side of the bin.

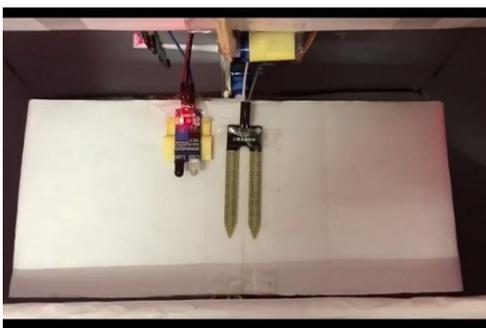


Fig. 6 Top view of the system.

Fig 7 shows dry waste dumping towards right side of the bin, IR sensor and servo motor are used to perform this task. When IR detects the dry waste then it will be dumped towards the right side of the bin.

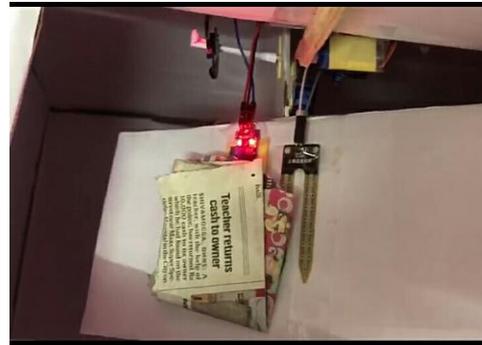


Fig.7 Dumping towards right side.

Fig.8 shows Wet waste Dumping towards left side of the bin, Soil Moisture sensor and servo motor are used to perform this task. When Soil Moisture Sensor detects the wet waste then it will be dumped towards the left side of the bin.



Fig.8 Dumping towards left side.

Fig.9 shows the detection of Flame inside the bin, Flame Sensor and Buzzer are used to perform this task. When the Flame Sensor detects the fire catchment then the Buzzer is alerted.

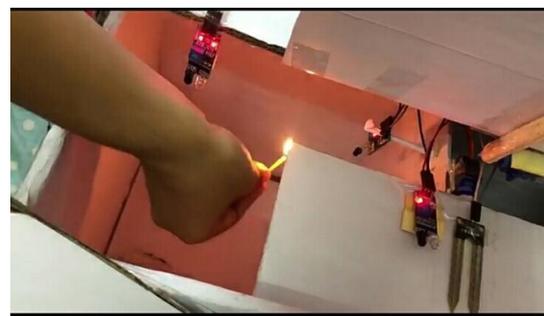


Fig.9 Flame detection inside the bin.

The Status of the bin is shown on the Blynk App. Fig.10 and Fig.11 shows the Status of wet side and dry side of the bin respectively. When wet side of the bin is full left

side LED will be blinked, displaying the message as wet bin full and when dry side of the bin is full, right side LED will be blinked displaying the message as dry bin full on the Blynk App.

A notification is sent to municipal authority when the dustbin is full. Thus, the authority can take quick actions by cleaning the bin as soon as possible.

Fig.12 and Fig.13 shows the notification that the dustbin is full in blynk app & also in lock screen. This notification can also be sent to user, so the authority will come to know about the status of the bin priory.



Fig.10 Status of wet side of bin.

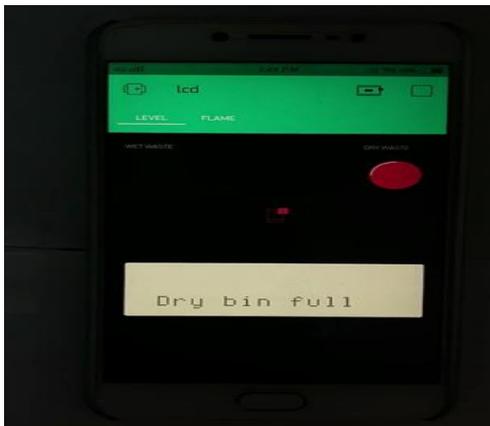


Fig.11 Status of dry side of bin.

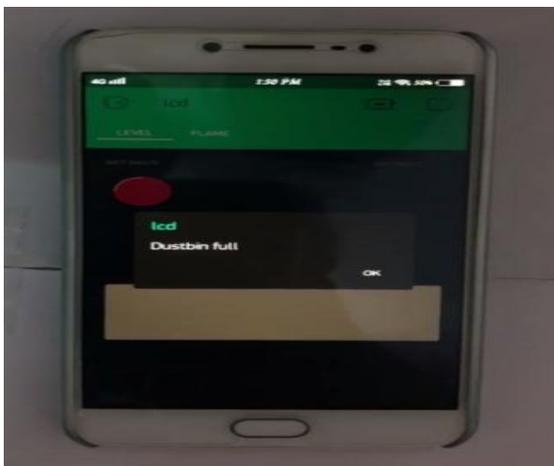


Fig.12 Notification in Blynk app.



Fig.13 Notification on lock screen.

V. CONCLUSION

The Smart waste monitoring system provides the way to help the public and authority, to maintain the city clean. Buzzer will alert regarding the fire catchment thus can be extinguished as soon as possible. The system provides the status of the dustbin in the Blynk app. The user can check the status priorly and it saves the time and helps people to throw the waste only in the dustbin and not elsewhere in the city. It automatically segregates dry and wet waste thus it saves the time of manual segregation by waste collector.

VI. FUTURE SCOPE

The system can be incorporated with GPRS to get the location of the bin in the area so that the user can dump the waste to nearest bin. An advanced feature of finding the next nearest bin if the current bin is full can also be incorporated. Also load sensor can be used for giving an alert if the weight of the dustbin has reached the threshold value set.

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