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Smart Waste Monitoring System using IoT

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Abstract – *Waste disposal and monitoring are some of the major problems that the world is facing irrespective of their economic or social status. This is majorly seen when trash bins in busy towns and villages are overflowing with wastes which might lead to an unhealthy environment and maybe a reason for the spread of diseases. To avoid this condition and maintain public health and cleanliness. This paper proposes an idea that can interpret the real-time status of all bins situated in various parts of the city by sending an alert signal to the municipal workers for immediate cleaning of a dustbin with proper verification based on the level of garbage filling, moisture, and temperature. It reduces the manual process of monitoring and verification.*

Keywords- Internet of Things (IoT), Ultrasonic Sensor, Arduino Uno, GPRS Module.

I- INTRODUCTION

India comes under the category of developing nations. Separation of waste is crucial for apt disposal of a huge quantity of trash which is been produced in our daily routine from various sources. People became used to just throwing things away and never realizing the consequences of their actions as seen in fig1. Problems like health hazards, pollution, environmental disturbance can take place due to an appropriate system of management. Urban areas with developing economies face poor waste collection services and fail in the management of dump collection which worsens the problem.

The waste collection method that is been implemented in many countries is a challenge and the majority struggle due to weak guidelines and rapid urbanization. At present, the volume of municipal solid waste is increasing drastically with an increase in the rate of population, economic uprising, industrial development, change in consumption habits, and many other factors in the lifestyle of the urban population.

It is alerted to the management company about the area that has to be visited to pick the overflowing or the bin that is nearing its saturation level so that the scavenger allotted may reach in prompt time and clear it.

Fig.1: Dustbins in the locality

The concept of the Internet of Things (IoT) is something in which surrounding things are connected using wired or wireless communication without manual intervention. Internet of Things as a technology performs sensing, activate, data assembly, storing, and processing by connecting devices to the Internet. This paper aims to plan for a handy solution to the problem that most economies are facing today. The monitoring system enables the period by which the bin will be filled. Ultrasonic sensors will measure the distance between the lid and communicate it to the server and it can also be seen through mobile applications.

II- PROPOSED TOPOLOGY

The proposed waste management is based on a cluster of sensors and controllers. The ultrasonic sensor detects the height of the trash bin. If the garbage container is about to fill a notification is sent to the respective authority. Wet and dry wastes are separated and collected in different containers.

It is done using the moisture sensor and IR sensor where the moisture sensor detects the wetness in the waste only when the wet container is opened. Once the garbage container is filled in a particular area, the garbage collector can locate the filled garbage container and can collect the waste. Two of the important features include is checking the volume that the bin can hold and the other is interpreting the data and sending it to the cloud system for monitoring.

Wastes are majorly classified as recyclable waste, industrial waste, hospital waste, commercial waste, green waste, electronic waste, nuclear waste and organic waste. They are categorized based on the source that is producing the waste. The current trend involves where people used to dump the garbage anywhere without segregation.

This leads to poor hygiene around the place becoming a source of the vector. This is the time when the scavenger should take the utmost care. So, the proposed system would be beneficial to scavengers and also the person in charge of monitoring the process.

III - MATERIALS AND METHODOLOGY

To overcome the problem, a smart-bin is developed in such a way that the trash cans are monitored 24x7. The whole setup consists of Arduino UNO as the primary controller which is the main processing unit connected to the internet working on the principles of the Internet of Things. Along with it, an ultrasonic sensor, moisture sensor, and temperature sensors are connected along with a servo motor. The controller establishes a connection with the cloud and based on the output from various sensors the controller receives command over the cloud and can be controlled via mobile application as it is in Fig.2 and the flowchart for the same is shown in Fig 3.

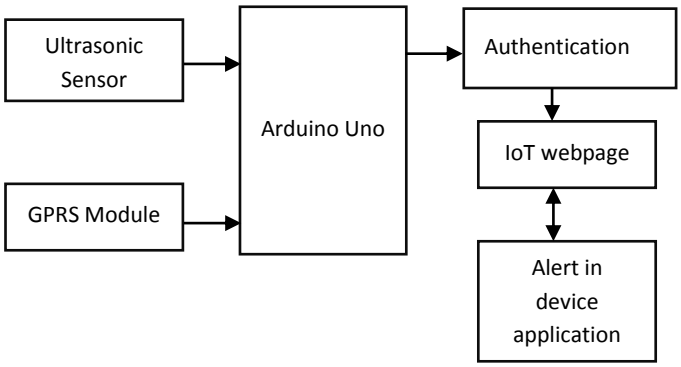

Fig.2: Block Diagram of Waste Monitoring

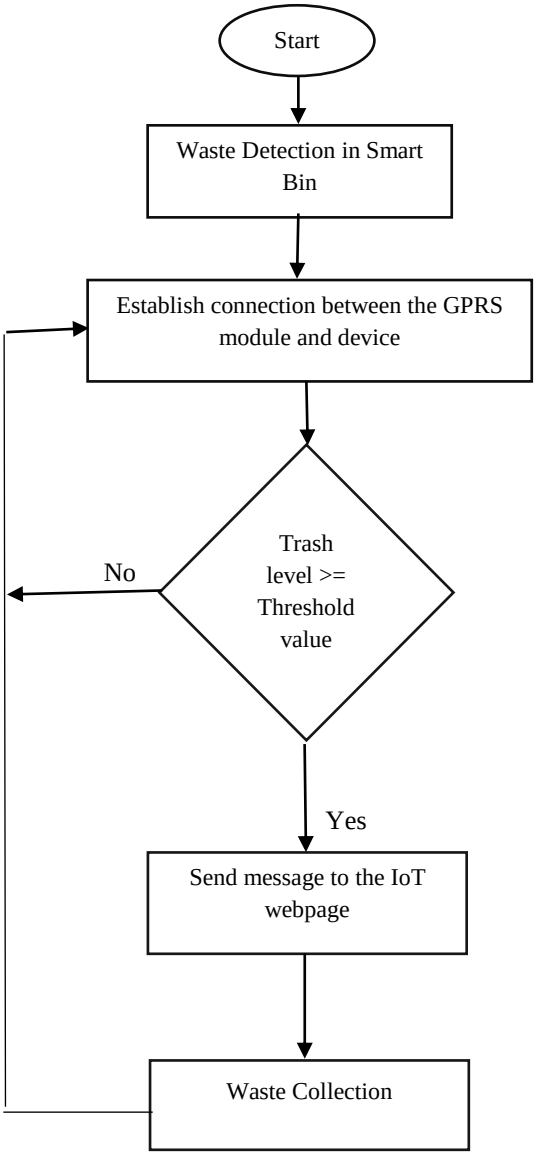

Fig.3: Flowchart of waste monitoring

III - PROPOSED ALGORITHM

The hardware kit and device(laptop/mobile) are connected to each other. The ultrasonic sensor detects the level of trash in the bin and the 4 LEDs connected to the bin tell the level of trash which are EMPTY, LOW, MID and FULL respectively. A connection is established by the Arduino Uno with the IoT webpage. When the trash level is above the threshold level, an alert is sent to the concerned authorities via mobile/laptop application. If the garbage or temperature does not exceed the threshold level then the process gets repeated. Then, the GPRS module sends the location to the IoT webpage and the LCD screen displays the output on the screen as soon as the IoT webpage is updated it shows the google location and level of the bin on the screen. The connected SIM in the GPRS module will send the message to the main authority about the garbage level. This is an application-based project for the real world and a solution project for the problem statement.

V- Experimental Prototype

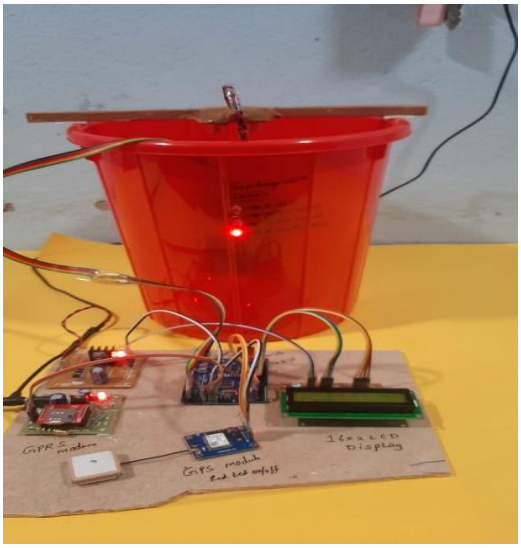

Fig.4: Experimental prototype of Smart waste management

The hardware kit consists of a bin, ultrasonic sensor, LEDs, power supply, Arduino UNO, GPRS Modem, GPS module and LCD. An Android application is developed to have remote control and track the level of various trash cans that need to be evacuated. Here the android application is used to monitor the level of the garbage bins. The mobile application is enabled two-way communication between the IoT. The table of the hardware components with the ratings is given in Fig.5.

Table.1: Hardware Components of the experimental circuit

Sr. No	Component	Rating
1	Ultrasonic Sensor	40 kHz, 5V, 20 mA
2	Arduino UNO	16 Mhz,6-20v,20 mA
3	GPRS Modem	SIM900A, 5V
4	GPS Module	5-10 Hz,3.3 V,30 mA
5	LCD Display	4.7 to 5.3 V, 1 Ma

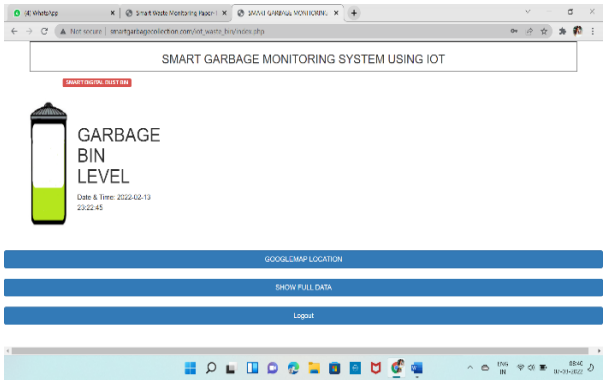

Fig.5: IoT webpage created for waste monitoring

The above Fig.6 shows the level of the garbage bin on the webpage created. Also, the status of our bin and the location can be seen in Fig.7 and Fig.8. This IoT webpage is created using embedded C in Arduino compiler as our main microcontroller is Arduino UNO. This application can be opened on any device like mobile/laptop which is connected with the GPRS modem of our kit. Also, the latitude and longitude value of our location is displayed on the screen.

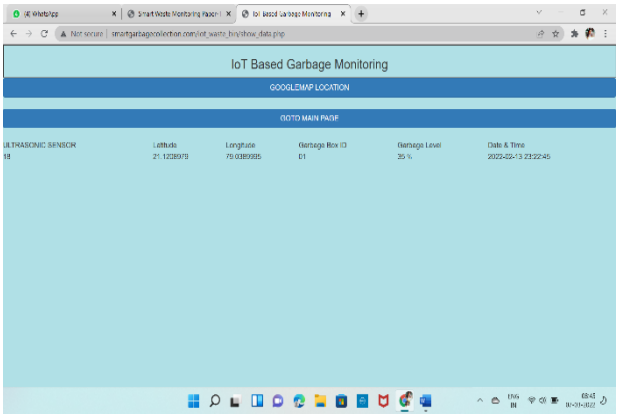

Fig.6: Present Status of the bin

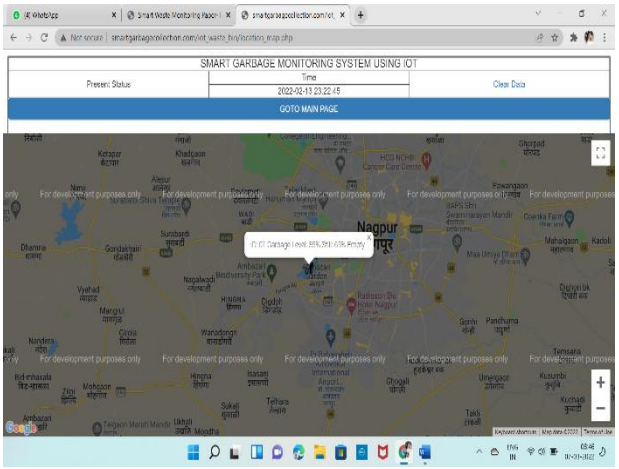

Fig.7: Google location of the bin

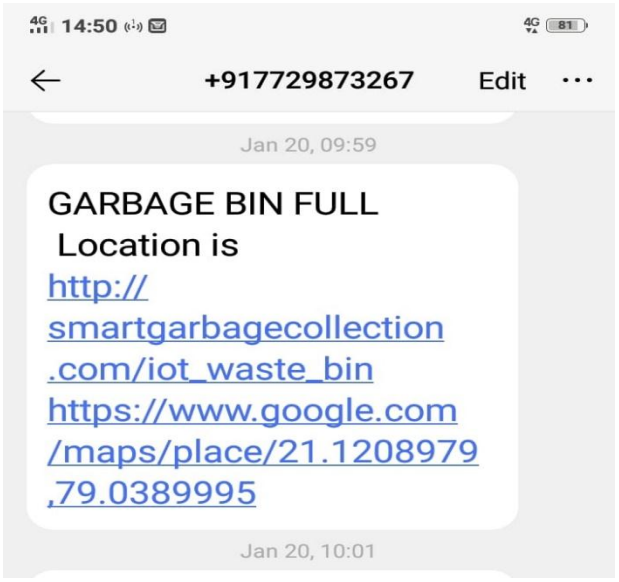

Fig.8: Message sent to the device

The alert message is sent to the mobile device which is shown in fig.9. The controller sends various information related to the bin regarding its distance, if it exceeds the threshold value it pops out a notification as "GARBAGE BIN FULL".

The output from the mobile application prompts the personnel that the bin has reached its maximum limit so that it has to be evacuated as soon as possible. The IoT-connected device sends and receives data to the mobile application connected by establishing two-way communication between the devices. The database stores all the information related to the bin and over a while, the system is designed in such a way to update the IoT webpage and keys for the Arduino Uno for its proper working for a long while enabling less maintenance and making it cost-effective.

The ultrasonic sensor only detects the level of garbage in the bins. This sensor will work suitably only if Arduino Uno will process the data from the sensor and then it will communicate the data with the IoT webpage through GPS location.

The dashboard designed in the IoT platform will show the level of the trash in the bin which can be accessed only by municipal authorities having access to the credentials. As the level of the trash is above the threshold level, the web page will generate an alert notification in the mobile application of the worker for that specific dustbin demanding cleaning process.

IV - CONCLUSION

The model is developed in standard conditions for testing purposes. In our city, many of the garbage bins can be seen as overloaded. It creates an unhygienic condition in that place and leads to the spread of many diseases. It is proposed to develop an IoT based smart waste management system that effectively checks whether the garbage bins are full or not. By implementing this system, the cleanliness of the area can be ensured and can avoid the spread of diseases, and also the cost associated with garbage disposal can be reduced. The various sensors have been used to implement in real-time.

This system effectively monitors the garbage level of the dustbin. It is to help the local corporation in the waste management system, which is by monitoring the domestic wastage in and around the localities at regular intervals to avoid damage to public health and the environment which also minimizes the entire trip by garbage vehicles which ultimately reduces the expenditure. In the future, various types of sensors can be included to get precise output. As this system reduces manual work and time consumption, it is a user-friendly product.

This proposed product is an attempt to improve the current waste collection system in India and pave a path for an eco-friendly environment. This proposed system ensures the maintenance of garbage containers as and when the garbage level reaches its saturation level. This minimizes the frequent checking of garbage collection. It ultimately aims in maintaining the cleanliness and productivity of society. Therefore, the waste monitoring and management system make the trash collection more efficient and effective.

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