Garbage Management Using Internet of Things

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Abstract— Increasing population and unhealthy lifestyle in urban and semi-urban areas is giving rise to catastrophic decline in cleanliness of surroundings. Recently there are several government programs and NGOS that are focused in making people aware in keeping their surroundings clean. This paper discusses about a system designed using Internet of Things (IoT) which informs organization as soon as garbage bin is full. Organization may include government body or any private firm that is responsible for garbage collection. Various sensors help detecting when the garbage bin is full and then via telegram it will inform the organizations to act. Gas sensor helps to detect toxic and harmful gases. To detect fire in garbage bin temperature sensor is placed, if the temperature goes beyond the predefined threshold value or presence of harmful gas is detected, alarm will be raised to alert the nearby people and organization will be notified using telegram. This will help to keep the polluted places clean in a smart and effective way. The organization will be notified by the system automatically, when the garbage bin is filled, which reduces time for manual checking.

Keywords— IoT, sensors, RPI

I. INTRODUCTION

Garbage management is major concern around the globe. Garbage is generated from kitchen waste, paper, shops, hotels etc. This garbage is difficult to manage, when they mixed and dumped. It takes lot of human effort to segregate these wastes. So, it becomes to segregate the waste before dumping in the dumping area. Sometime even after segregating the waste due to improper management of waste, lot of garbage is spread around since garbage bin become full, this may lead to arise of unpleasant smell as well as it become home of many insects. Garbage if not managed properly leads to release of toxic and flammable gases in the environment. It also leads to contamination of ground water, if any harmful metal like mercury, arsenic is present in dumping area, metals seeps through soil and makes the water polluted.

The garbage if not managed properly leads to spread out on roads may leads to contamination of foods and water carried by flies. There is also chance that due to garbage dumped in an area and not cleared for long time, may sometime leads to release foul smell or toxic gases. The flammable gases like methane may leads to fire in dumping area, or toxic gases released may be threaten to human life, who are living around the garbage area. Therefore, garbage should be segregated into dry and wet waste so that it is easy to manage garbage. Further new technology came which automatically alert the concerned authority or truck driver

whenever the garbage bins are full or any presence of toxic and flammable gases in garbage bins like using IoT technology where sensor is detecting the level of garbage and presence of toxic and flammable gases. The other technology is location intelligence, using this truck driver can get the exact location of garbage bins in an area and can collect the garbage bins on time.

In Bangalore, there are many places where garbage collected is dumped, one of them is Begur road is the area where garbage collected from nearby area is dumped. In most of the cities in India the garbage is segregated before dumping into ground as dry, wet waste. Small towns or rural areas, there is no segregation of garbage bins before dumping the garbage. The garbage collectors need to manually separate the garbage, which is time consuming and causes illness among workers. The garbage collectors should take precautions, before handling the garbage by wearing mask or gloves.

In most of the dumping places, workers will burn the plastic materials, which cause pollution to environment and lead to many respiratory diseases like asthma. The plastics or any metal instead of burning them can be recycled for future use.

The Indian government also took initiative to make the cities and villages clean and healthy by launching a program called Swachh Bharat. Honourable Prime Minister Shri Narendra Modi launched this program on 2nd October 2014. With the help of this program, people became more

aware and took initiative to make the cities and villages clean. Many applications were launched by government to make this program more effective, such as Swachh Bharat Abhiyaan App. The Swachh Bharat Abhiyaan app is very easily gets installed in smart phones, the person needs to open this app and click picture of waste or dumping area. The taken picture will be uploaded on the Swachh Bharat National Server, along with its location of image taken, time and date of upload. The concerned authority will then take actions by sending the workers to clean the area.

So, we are developing a cost-effective system and portable system using internet of things (IoT) technology to be used in garbage bins to check whether garbage is full or not using ultrasonic sensor, detecting toxic and harmful gases presence using Mq-135 gas sensor and detecting fire in the bins using temperature sensor. All the data by sensor will be sent to raspberry pi 3 for processing. We are using telegram, which is connected to raspberry pi 3 and all the processed data will be sent to telegram to notify the authorities. IoT devices are communicating among each other and share data among each other via internet.

II. LITERATURE SURVEY

In paper [1] author makes use of trending field of Internet of Things (IoT) to tackle waste for the construction of smart cities. Open street map is used for acquiring map of the detected location and uses cloud for storage, monitoring and analysis. Model is developed using Dynamic Scheduling algorithm to achieve the result. Applications suggested in this paper are that it automates the task by developing mobile app which shows location of the waste needs to be collected to the truck drivers. The waste management companies through web application monitor waste continuously.

In paper [2] author uses, trending fiend of IoT to transfer data collected through sensors and establishes a sensor field. Harmful gases are recognized and uploaded to cloud (Thingspeak) using WiFi. Uploaded data is analysed and sent to nearest vehicle mobile app to pick the garbage bin if it is full or any toxic gas start evolving. To recognize the correct location of garbage bin they are provided a unique number. To determine the shortest path Dijkstra's algorithm is used.

In paper [4] author focuses on trending technology of IoT and smart devices to monitor and locate bins. Data received form sensors are stored in OpenIoT (A cloud infrastructure) and uses Information and Communication Technology (ICT) for communication between sensor and cloud. To save battery they use near field communication to communicate between nearby sensors forming a wireless sensor network. Algorithm used in this paper is dynamic scheduling to decide exact time from where the picking of garbage bin will start.

In paper [5] author gives smart waste management system to clean cities by using IoT technology to manage and to remove waste from various location to the dumping area. Algorithm used is Graph Theory that helps in deciding faster pickup of the cans from scattered locations across city. To decide the route intelligently that used machine learning and big data to store data.

In paper [6] author finds minimal route to pick the bins using Capacitated Vehicle Routing Problem (CVRP) and to protect the pickup vehicle from visiting same location or less full trash location multiple time they used Backtracking Search Algorithm (BSA). Using above algorithm, they were able to reduce the emission of CO_2 in air by % and reduced the fuel consumption by 36%.

In paper [7] author uses, Life Cycle Assessment (LCA) and mathematical programming methods to protect environment by optimizing the food waste generated. Different case studies have been discussed in the paper that shows how food waste throws adverse impact on environment and using LCA they reduced waste.

In paper [8] author discuss about toxic substances that are present in e-waste and effect of e-waste on human's health. This paper uses different tools like Life Cycle Assessment (LCA), Material flow analysis (MFA), Multi Criteria Analysis (MCA) and Extended Producer Responsibilities (EPR) to manage the e-waste in developing countries.

In paper [9, 10] author introduced, automatic system that manages the waste by analyzing it and measuring it by the volume of waste dumped in trash bin. Sensors that are connected to trash bin sends weight and volume data to cloud server, these data further help in deciding which trash bin will be picked first so, to collect the waste at greatest amount. To find shortest path for trash bin collection, present position of vehicle and trash bin is used, to achieve this Ant Colony Optimization (ACO) technique is used for individual vehicle.

III. ARCHITECTURE AND IMPLEMENTATION

Ultrasonic sensor, MQ-135 sensor and DS18B20 Temperature Sensor are directly connected to Raspberry pi 3 and via telegram we can monitor the status of garbage bin as shown in Figure 1. With the help of Telegram app, the user will select start monitoring choice and the sensor will start sending data to user phone. The ultrasonic sensor will measure distance, in this system, we have set a distance and will send the status of bins whether full or half full to user. The temperature sensor checks that if temperature of bins goes beyond the threshold temperature, then alarm is raised to alert the nearby people and alert will be sent to user via telegram. The MQ-135 gas sensor will detect presence of toxic and flammable gases and will alert the user. The user can stop the monitoring via telegram if everything is fine and no changes occurred in parameter.
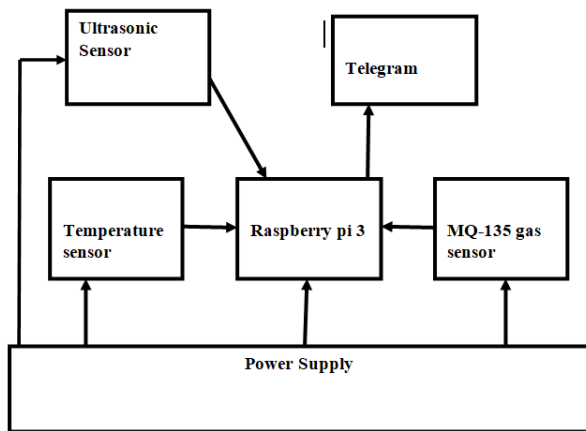
Figure 1: Block diagram

A. IMPLEMENTATION

Snippet read temperature value and sends data continuously to RPI for processing where data is compared with threshold value. When the reading crosses sensor value alarm is raised. The implementation is shown below.

```
def read_temp():
    lines = read_temp_raw()
    while lines[0].strip()[-3:] != 'YES':
        time.sleep(0.2)
        lines = read_temp_raw()
    equals_posn = lines[1].find('t=')
    if equals_posn != -1:
        temp_string_val = lines[1][equals_posn+2:]
        temp_b = float(temp_string_val) / 1000.0
        #temp_d = temp_b * 9.0 / 5.0 + 32.0
        return temp_b #, temp_d
```

The below snippet is used to measure distance using Ultrasonic Sensor and the measured distance is sent to RPI for processing. RPI compares the received distance with predefined threshold value to identify whether garbage bin is full or not.

```
#Ultrasonic Sensor
GPIO.output(TRIG, False)  #Set TRIG as LOW
        print "Waitng For The Sensor To Settle"

        GPIO.output(TRIG, True)  #Set TRIG as HIGH
        time.sleep(0.0001)          #Sets Delay for 0.0001
second
        GPIO.output(TRIG, False)  #Set TRIG as LOW
        while  GPIO.input(ECHO)==0:    #Check ECHO
should not be HIGH
                pulse_start = time.time() #Saves recent
occurrence time of LOW pulse
        while  GPIO.input(ECHO)==1:    #Verifies ECHO
should not be LOW
                pulse_end = time.time()    #Saves recent
occurrence of pulse which is HIGH
```

```
        pulse_time = pulse_end - pulse_start  #Get time till
pulse occured
        distance = pulse_time * 17150    #Multiply pulse
time by 17150 to find distance
        distance = round(distance, 2)          #Round to two
decimal values
        #Measure distance of garbage bin if its full or empty

        if distance > 5 and distance <=7:
                notify("garbage bin is 25% full ")
        if distance > 7 and distance <=14:
                notify("garbage bin is 50% full ")
        if distance > 14 and distance <=21:
                notify("garbage bin is 75% full ")
        if distance > 21 and distance <=28:
                notify("garbage bin is 100% full need
immediate pickup")
```

The below Snippet is used to detect the presence of methane gas, when methane gas is detected notification to authority is sent via telegram and alarm is raised to warn if near garbage bin any people is present.

```
switchstate = GPIO.input(18)
    if switchstate == GPIO.LOW:
        if (switchstate_old != switchstate):
            notify("Hazardous Gas has started forming")
            GPIO.output(22 , GPIO.HIGH)
            time.sleep(1)
            GPIO.output(22 , GPIO.LOW)
            time.sleep(1)
        else :
            GPIO.output(22 , GPIO.LOW)
    switchstate_old = switchstate
```

IV.   RESULTS

The circuit connection of garbage monitoring is seen in figure 2 below. The collected data from the sensor is sent to RPI for processing. Once data is processed it is matched with the threshold value, achieved result is sent via telegram. If any action needed to be performed is controlled by RPI like, triggering an alarm.
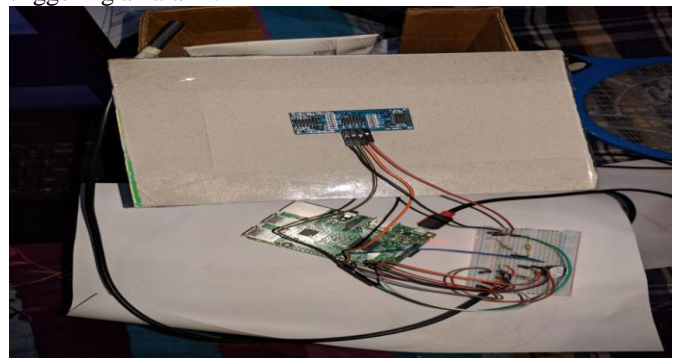

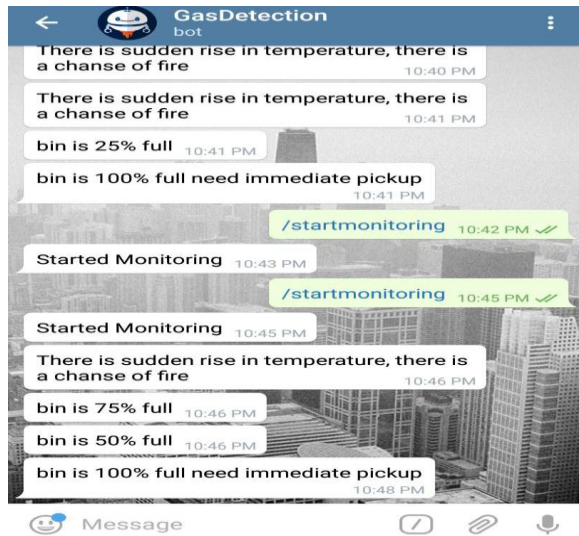Figure 2: circuit connection of sensors with RPI

Figure 3: screenshot of detection by sensor on telegram

Figure 3 tells information of garbage bin is shared to the organization via telegram along with the percentage of garbage in bin. In the case where fire is, detected or harmful gases are identified authority is warned and alarm is raised so that person near surrounding may take some basic action.

Figure 4: Snapshot of gas leakage monitoring

Figure. 4 tells that if any toxic or flammable gas is detected using MQ-135 gas sensor than it will alert the user via telegram.

V. CONCLUSION

Goal of this paper is to achieve healthy and dieses free surroundings. Organisation can continuously monitor amount of garbage filled in garbage bin placed at different locations around the area, using this system. If any of the garbage bin is full and if there is detection of any harmful and toxic gases or if any fire occurs in bins, then via telegram the authorities will be warned so that they can take required action. This system is very cheaper and easy to carry anywhere. So, we are developing a system, using sensor, which will automatically sense the garbage in a garbage bin and checks the presence of any toxic gases and alert the concerned authority or truck driver, so that periodically garbage can be collected to make the environment clean.

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