Garbage Management of Smart Cities using Internet of Things

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Abstract— As the population is increasing day by day, it should necessary to think about to make our environment healthy and clean. In this rapid majority of urban communities the flooded dustbins are making unhealthy environment. That wills the reason of various diseases in people living around. It will change the way of living people's life. To overcome these problems a smart Garbage Management using IoT has to be developed. That can be monitored remotely by the authorized person. It has alert system that makes it efficient great extent with Internet of Things. This is easy to use by people as it has worked with IoT. This paper is a brief description of Garbage Management of smart cities smartly using IoT.

Key words: IoT, ESP8266, Arduino UNO & Arduino IDE, Blynk App, Ultrasonic Sensor SR04

I. INTRODUCTION

Now day's Smart cities are developing fastly and become smarter with their smart services around the world but due to this fast development of smart cities a lot of garbage and waste increasing day by day. The managements of garbage become the biggest problem. Because of the absence of care and consideration by the peoples the dustbins are generally appear to be flooding. It must be to think about the problem of garbage management of smart cities dustbins with the help of technology. IOT Based Garbage Management system creates to defeat the situations of floods rubbish receptacles in the diverse urban communities. The INTERNET OF THINGS is the networking of hardware devices and communication between those devices. This system based on IOT (Internet of Things). This system is developed for a realistic scenario of the city, and utilizing properly accessible geo area information of the dustbins.

II. RELATED WORK

Proposed system delivers desired results. As wastes in the dustbin increase, the distance measured by the ultrasonic sensor placed at top of dustbin also reduces. When this distance becomes less than 25cm, a message is sent to the control room indicating the overflow along with the floor number of the dustbin. Before sending message to control room ultrasonic sensor check for 10sec whether the garbage level detected is correct or if it is false vale. If the detected vale is false vale, then ultrasonic sensor will not send any value and keep collecting further values. If values are true, then it will send message to control room. In control room there is GUI interface on MATLAB which will show cleaner's name, his mobile number, dustbin level and location of dustbin. Then, a message is sent to the cleaner of that floor. [1]

This paper can be implemented for apartment type buildings that may also include industries wherein, the demanded resource for the implementer or the designer is provided. Installation of the process includes tech bins, 2 conveyor belts (one for dry waste & the other for wet waste), IoT module to instruct & Underground bin facility. These tech bins (one for dry &another for wet waste) are kept on the either corner side of the apartment (in each floor) where the owner opts, but it should be a centralized view to ease the construction process. If the opted place of owner has all the resources given to the implementer then, the installation of project will be executed. The bins are infixed with level sensor (ultrasonic sensor) to indicate the weight and level of garbage in the bin. These bins have lids which will close automatically if it is 80% garbage in all bins in which automatic rotation of the conveyor belt is performed. If in partial cases, then the manual operation is done by switching the switches (one for backward & the other for forward) in each floor. When the operated bin reaches the ground floor, then the waste is dumped in the underground bin. When the conveyor belt rotates for one cycle the information or the database of the dustbin is made enabled to people to look in into the application called "Things view" (an android application) & for the municipal corporation of the city, via the mobile communication network, the signals are sent to a web-based software application which is view a dustbin (percentage of being filled) is sent to the control room, every passing hour [2]. An embedded based intelligent alert system is devised for the proper monitoring and maintenance of the garbage. This system averts their regular cleaning of the dustbins by sending alerts to the concerned individual at regular intervals. It further improves the system by additionally endorsing the status of cleaning in real time and measure the performance of the team. Thus this system comes in handy as an admirable solution in environmental maintenance. In addition to this it also aids to diminish the need for high human intervention in garbage maintenance of the municipality and pollution monitoring system [3]. This project work is the implementation of smart garbage management system using IR sensor, microcontroller and Wi-Fi module. 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. This system also helps to monitor the fake reports and hence can reduce the corruption in the overall management system. This reduces the total number of trips of garbage collection vehicle and hence reduces the overall expenditure associated with the garbage collection. It ultimately helps to keep cleanliness in the society. Therefore, the smart garbage management system makes the garbage collection more efficient. Such systems are vulnerable to plundering of components in the system in different ways which needs to be worked on [4]. In this project, an integrated system of Wi-Fi modem, IoT, GSM, Ultrasonic Sensor is introduced for efficient and economic garbage collection. The developed system provides improved

database for garbage collection time and waste amount at each location. We analyzed the solutions currently available for the implementation of IoT. By implementing this project we will avoid over flowing of garbage from the container in residential area which is previously either loaded manually or with the help of loaders in traditional trucks. It can automatically monitor the garbage level & send the information to collection truck. The technologies which are used in the proposed system are good enough to ensure the practical and perfect for solid garbage collection process monitoring and management for green environment [5].This implementation of Smart Garbage collection bin using IoT, IR sensor, microcontroller and GUI. 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. This system also helps to monitor the fake reports and hence can reduce the corruption in the overall management system. This reduces the total number of trips of garbage collection vehicle and hence reduces the overall expenditure associated with the garbage collection. It ultimate helps to keep cleanness in the society. Therefore, the smart garbage management system makes the garbage collection more efficient the use of solar panels in such systems may reduce the energy consumption. Such systems are vulnerable to plundering of components in the system in different ways which needs to be worked on. These dust bin model can be applied to any of the smart cities around the world. A waste collecting and monitoring team which is deployed for collection of garbage from the city can be guided in a well manner for collection [6].

III. PROBLEM STATEMENT

As we have seen number of times the dustbins are getting overflow and concern person don't get the Information within a time and due to which unsanitary condition formed in the surroundings, at the same time bad smell spread out due to waste, bad look of the city which paves the way for air pollution and to some harmful diseases around the locality which is easily spreadable.

A. Problems in Existing Systems

- So many dustbins in the city not filled by the garbage, higher authorities not even aware about this.
- Trucks visit one location again and again in a same day.
- Time consuming and less effective.
- Trucks visit empty dustbins so many times due to lack of communication.
- More traffic and Noise.
- Difficult to find which dustbin is filled or empty.
- Cost of existing systems is very high.
- It's not easy to access for the peoples living around the city.

IV. PROPOSED WORK

- Literature survey has been performed for garbage management of smart cities smartly this system based on IoT and to find out effective methods which are useful for providing hygiene environment in cities.
- All the existing system work on single level that means they only shows that garbage bin is filled or empty then the system send the status of the garbage bins to the authorities.
- Proposed system consists dustbin with SR04 Sensor and ESP8266, Mini truck, large truck, Controller with Blynk app.

A. Steps

1) Check dustbins is filled with the garbage or not, in particular time interval each dustbinhave Ultrasonic Sensor SR04 and ESP8266 share their status to the truck driver who have the blynk app for getting information. If waste in the dustbins cross the threshold then the status of each dustbin is send to the truck driver on his smartphone in Blynk App.
2) Primary Truck finds the shortest path through Blynk app on his smartphone for all the dustbins which filled with the garbage Identified route and all filled dustbins marked locked for cleaning.
3) Then Primary truck collect the garbage of all the dustbins and that collected garbage is transferred to large truck standing somewhere in the city.
4) Now same process is followed by secondary truck and tertiary truck and this process regularly rotated from primary truck to secondary truck, secondary truck to tertiary truck then tertiary to primary truck and all the garbage is transferred to the large truck.
5) If dustbins not filled by the waste for a long time so this system notifies the authorities regarding the status of the dustbin which is empty for a long time.
6) If trucks not visited the location of overflow dustbins on the given time so automatically this system notify the authorities, If the authorities not take any action regarding this complains so this system send the information to the higher authorities.

B. Pseudo Code

1) Start
2) Entities:
- Dustbins: D1, D2, D3 ... Dn;
- Trucks: T1, T2, T3;
- Blynk App:B;
- Controller: C; // C has:
  ArrayOfDustbinsIds [D1, D2, D3..] &
  ArrayOfTrucksIds [T1, T2, T3] &
  Map<blynk App, truck>.
  Authorities: A;

3) I - C puts map<blynk App, T1>; // Truck having blynk app will collect the waste and getting notified by dustbins.
   II - C sends T1-ID to arrayOfDustbinsIds []; // Dustbins knows to whom I have to send signal once filled.
4) If Dustbin fills > threshold
   Then Dx notifies T1: x = 1 || 2|| 3...||n;
   And notifies C: C removes Dx from arrayOfDustbinsIds [];
5) If T1's Dustbin count == 10 // count reaches to 10
   Then T1 notifies C and calculates shortest path to reach dustbins to collect waste.

6) 1. IfT1.locationFlag! = true // this flag becomes true when T1 reaches to Dx location for collecting waste
   Then T1 calls notify Authority A
   Else continue
   After getting emptied Dx notifies to C to add in arrayOfDustbinsIds []
   Then after dumping all the waste when truck returns then T1 notifies C.
   Then C adds T1 in arrayOfTrucksIds []
7) C: removes T1 from arrayOfTrucksIds [];
8) C: Repeat step 3.ii // with map<blynk app, T2>. C fetches here next truck available in
   ArrayOfTrucksIds [] and puts in the map.
9) Stop.

V. PLATFORM, HARDWARE & SOFTWARE

- ESP8266
- Arduino IDE
- Arduino UNO
- Ultrasonic Sensor SR04
- Blynk App

A. ESP8266

The ESP8266 can be controlled from your local Wi-Fi network or from the internet (after port forwarding). The ESP-01 module has GPIO pins that can be programmed to turn an LED or a relay ON/OFF through the internet. The module can be programmed using an Arduino/USB-to-TTL converter through the serial pins (RX, TX) [https://maker.pro/esp8266].

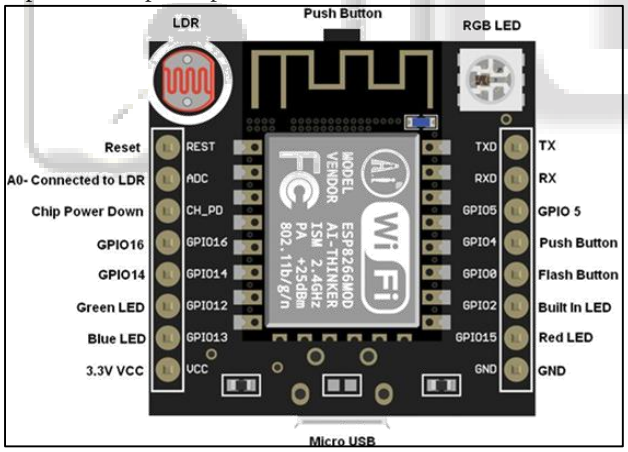

Fig. 1:

B. Arduino IDE

The open-source Arduino Software (IDE) makes it easy to write code and upload it to the board. It runs on Windows, Mac OS X, and Linux. The environment is written in Java and based on Processing and other open-source software. This software can be used with any Arduino board.

C. Arduino UNO

Arduino is a single-board microcontroller meant to make the application more accessible which are interactive objects and its surroundings. The hardware features with an open-source hardware board designed around an 8-bit Atmel AVR microcontroller a 32-bit Atmel ARM. Current models consists a USB interface, 6 analog input pins and 14 digital I/O pins that allows the user to attach various extension boards. The Arduino Uno board is a microcontroller based on the ATmega328. It has 14 digital input/output pins in which 6 can be used as PWM outputs, a 16 MHz ceramic resonator, an ICSP header, a USB connection, 6 analog inputs, a power jack and a reset button. This contains all the required support needed for microcontroller. In order to get started, they are simply connected to a computer with a USB cable or with a AC-to-DC adapter or battery. Arduino Uno Board varies from all other boards and they will not use the FTDI USB-to-serial driver chip in them. It is featured by the Atmega16U2 (Atmega8U2 up to version R2) programmed as a USB-to-serial converter.

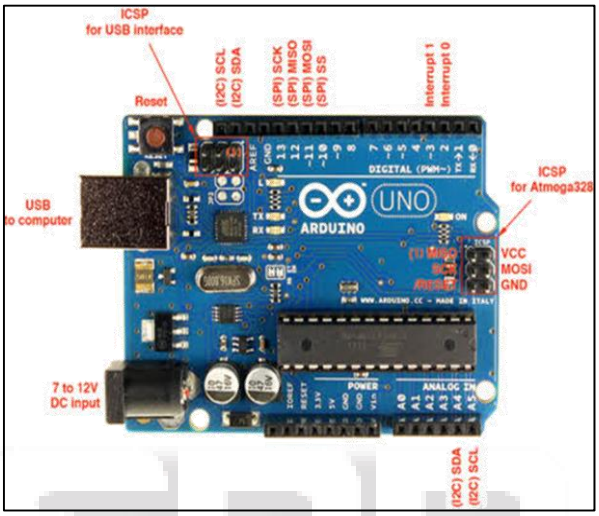

Fig. 2:

D. Ultrasonic Sensor SR04

The HC-SR04 ultrasonic sensor uses sonar to determine distance to an object like bats do. It offers excellent non-contact range detection with high accuracy and stable readings in an easy-to-use package. From 2cm to 400 cm or 1" to 13 feet. Its operation is not affected by sunlight or black material like sharp rangefinders are (although acoustically soft materials like cloth can be difficult to detect). It comes complete with ultrasonic transmitter and receiver module.

1) Features

- Power Supply: +5V DC
- Quiescent Current: <2mA
- Working Current: 15mA
- Effectual Angle: <15°
- Ranging Distance: 2cm – 400 cm/1″ – 13ft
- Resolution: 0.3 cm
- Measuring Angle: 30 degree
- Trigger Input Pulse width: 10uS
- Dimension: 45mm x 20mm x 15mm

The ultrasonic sensor uses sonar to determine the distance to an object. Here's what happens:

1) The transmitter (trig pin) sends a signal: a high-frequency sound
2) When the signal finds an object, it is reflected and
3) The transmitter (echo pin) receives it.

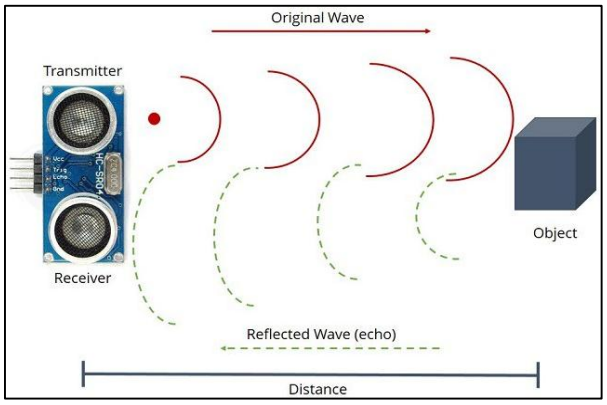

Fig. 3:

E. Blynk App

Blynk was designed for the Internet of Things. It can control hardware remotely, it can display sensor data, and it can store data, visualize it and do many other cool things.

- There are three major components in the platform:
- Blynk App - allows to you create amazing interfaces for your projects using various widgets we provide.
- Blynk Server - responsible for all the communications between the Smartphone and hardware. You can use our Blynk Cloud or run your private Blynk server locally. Its open-source could easily handle thousands of devices and can even be launched on a Raspberry Pi.
- Blynk Libraries - for all the popular hardware platforms - enable communication with the server and process all the incoming and out coming commands.

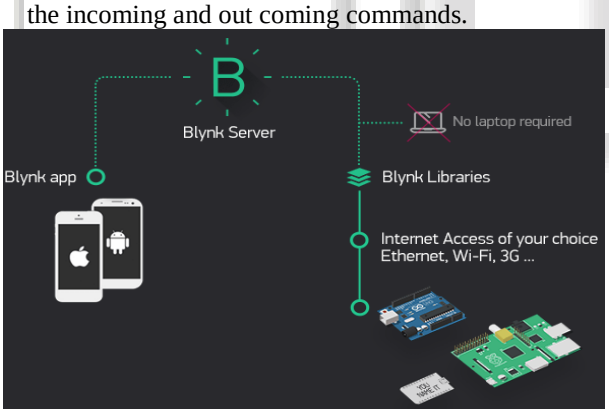

Fig. 4:

VI. IMPLEMENTATION

1) Firstly downloaded and installed the Arduino and added information of the board ESP8266 to the ArduinoAnd in Arduino IDE introduced into the box Additional Boards Manager URLs, the address of the board of JSON file ESP8266.
2) Managed ESP library and in the Arduino IDE added the library of ESP8266.
3) Installed blynk application in every truck driver smartphone. Created an account with email and password. We have to open a new project and give it a name and select our board, (Arduino UNO ESP8266WI-FI).The Blynk Server will send "YourAuthToken". Copy it into the Arduino code. Go to the widget box and add visit terminal on virtual V12. After Uploading the code the board can be disconnected from the computer and powered by an externally separately source. It will become a work and send the data to the smartphone.
4) Installed ESP8266 and Ultrasonic Sensors over the dustbins and connected with Blynk app through coding in the ESP8266.
5) Mini truck will act as subscriber for method named "Garbage".
6) All nearby dustbins having ESP8266 and SR04 sensor will be publisher for method named "Garbage".
7) Whenever any dustbin will be in full status, it will publish garbage method.
8) The active mini truck will receive all messages at a particular time from all full dustbins on his mobile in Blynk App.
9) The messages will have dustbins ID's whose fixed location is in mini truck ESP8266 database.
10) The mini truck will handle according to decided path and collect garbage and dustbins status is set to empty.

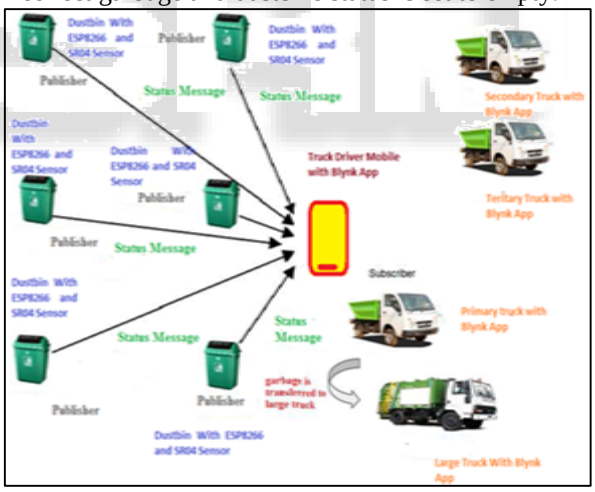

Fig. 5:

VII. COMPARISON OF EXISTING & PROPOSED WORK

Sr No	Parameters	Existing Work	Proposed Work
	DUSTBIN STATUS	Based on historic method	Based on Current Status
	TIER	Single TIER(Only dustbins Empty and filled status is received by authorised person	MULTITIERS (The system is automated at dustbin tier& admin console, large truck management is kept manual.
3.	FUEL CONSUMPTION	Very HIGH	LOW (Cause all Updation getting in Mobile through Blynk App
4.	USED HARDWARE DEVICES COST	Very Costly	Easily Affordable

5.	ROUTE OPTIMIZATION	Based on Old Data	Based on Real time Alert of. Filled Dustbins.
6.	TRUCK VISITING	Visit Filled as well as Empty Dustbins	Visit only Filled Dustbins
7.	TIME CONSUMPTION	It Takes a lot of time.	It is Faster than Existing method.

Table 1:

VIII. CONCLUSION & FUTURE WORK

This implementation has been done for collecting the details of Garbage Management of Smart Cities Smartly based on IOT and to identify best methods that are useful for providing healthy environment in cities. As the level of garbage in the dustbins crossed the threshold, it will be informed to the authorized person, if it was found ignored by the authority then the details will be forwarded to higher authority person to take necessary actions. Thus a healthy and clean environment can be provided. This survey helps in identifying all the possible techniques for garbage management smartly that can be implemented to make city clean.

If we talk about future enhancement. The technique can be enhancing by using more small trucks and one bigger truck. Small truck will easy to go at small areas or roads and bigger truck collect more waste collected by small trucks.

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