Advanced And Efficient IoT Based Smart Bin For Health And Hygiene

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Abstract- *These days certain moves are made to enhance the dimension of tidiness in the nation. Individuals are getting increasingly dynamic in doing every one of the things conceivable to clean their environment. Different developments are likewise begun by the administration to expand neatness. We will fabricate a framework which will tell the enterprises to clean the bins on time. This framework will help keep the environment clean, healthy and hygienic.*

Keywords- Health and hygiene, Internet of things, Smart dustbin, Waste management.

I. INTRODUCTION

Waste management is collection, transportation, and disposal of garbage, sewage and other waste products. Waste management is the process of treating solid wastes and offers variety of solutions for recycling items that don't belong to trash. It is about how garbage can be used as a valuable resource. Curbside collection is the most common method of disposal in most countries, in which waste is collected at regular intervals by specialized trucks. Waste collected is then transported to an appropriate disposal area.

Nowadays, cities with developing economies experience exhausted waste collection services, inadequately managed and uncontrolled dumpsites and the problems are worsening. Waste collection method in such countries is an on-going challenge and many struggle due to weak institutions and rapid urbanization. It can be resolved with efficient and effective automated systems. We will fabricate a framework which will tell the end users to exhaust the bin on time.

II. LITERATURE SURVEY

A.Smartbin: Smart Waste Management System

Folianto, *et al.*[1] proposed a system that identifies the when a litter bin is completely full. In this system, data is collected and transmitted via a wireless mesh network. Moreover, to reduce the amount of power consume and maximize the time efficiency of the operations, the system employs duty cycle technique. However, the technology employed uses short range connection for the system such as WiFi and Ethernet Internet connections. Also, the use of ultrasonic sensors used affected the optimum performance of the system, because these sensors are sensitive to certain temperature variation.

B.IoT based smart garbage and waste collection

Navghane *et al.*[2] also proposed a smart waste collection bin using the combination of sensors such as weight and infrared (IR) sensors. The IR sensors will show the various levels of garbage in the dustbin and activate the weight sensor to transmit the results ahead when its threshold level is reached. The receiver end has to be connected to the WiFi as well to monitor the readings. However, the limitation of the system is that IR sensor can't provide accurate readings in dark conditions which is certain to be there inside a closed bin.Apart from this weight alone doesn't suffice. It is unable to detect actual percentage of bin filled and available as liquid and solid weights doesn't indicate depth of bin filled at any instant of time.

C.Intelligent System for Garbage collection

Najaf Ali*et al.*[3] proposed a garbage collection system that makes use of ultrasonic sensor to detect height of bin filled and if it exceeds 80% send signal to web application. Amount of data that can be sent is limited and security mechanisms not followed. It doesn't account for garbage that is producing foul smell being kept unattended for several days. Centred around single WiFi, credentials of it been hardcoded to the board. Hence renders the system unsecured and limited reliability for connection.

D.Efficient IoT based Smart Dustbin

Archana *et al.*[4] has devised an improvised version of smart bin which has incorporated use of temperature sensor in addition to sonar-infrared sensors setup, which is used to monitor thermal conditions within the bin. If it exceeds the acceptable range which signifies enormous generation of heat

due to chemical reactions or some item dumped into the bin, end users has to be notified immediately for its disposal. It has similar security and reliability flaws as specified earlier. The web application used can't be customized and access is limited.

E. Systematic IoT based smart bin for tidy ambiance

Kandasamy *et al*[5] proposed a unique smart bin that makes use of gas sensor, ultrasonic sensor and infrared sensor. The bin not only detects the capacity available but detects release of unsafe gases. It has limited scalability. Mechanical components used are susceptible to wear and tears which will affect working of the system incurring high maintenance costs. System doesn't account for reliable connectivity in case specified WiFi is down and the security mechanism used is vulnerable to brute force attacks.

III. EXISTING METHODOLOGY

In the current framework, a HC-SR04 ultrasonic senor or IR sensor placed inside the bin to its cover which will recognize the trash level. At the point when the level of the trash reaches the threshold, a notice will be sent to the enterprise's office, at that point the representatives can take further activities to purge the container. Notwithstanding this gas sensor is connected to hint the development unsafe gas in the receptacle and IR sensor is joined to distinguish human to open the canister consequently.

IV. LIMITATIONS OF EXISTING SYSTEM

In the Infrared (IR) based smart bin, an IR sensor has been setup inside the bin which is subjected to several problems like IR sensor doesn't work in dark environment which is very likely to happen inside the bin. Due to different degree of angle of reflection, refraction, shininess and other optical properties of the garbage inside the bin, the beam of light might not be traced back to receiver.IR sensor can't produce correct reading if waste contained is wet waste.IR sensor deployed to detect person coming nearby can't distinguish between humans, animals and other solid bodies.

In the Ultrasonic sensor based smart bin, an Ultrasonic sensor has been setup inside the bin. Ultrasonic sensors have a minimum sensing distance. Beneath which erroneous reading is obtained which is likely to happen when bin is filled to the brim and yet unattended. HC-SR04 type ultrasonic sensor is usually used which isn't much precise. On opening the lid, ultrasonic sensor might detect very long range beyond dimensions of the bin, producing incorrect reading. It does not account for garbage been accumulated at one region. Also the height of the bin is usually hard coded. The solution must be generic such that its applicable to variable bins.

V. PROPOSED METHODOLOGY

The framework to be comprised of ultrasonic sensor HY-SRF05. A temperature sensor to be installed inside the bin so as to formulate the ultrasonic sensor readings accordingly, since readings of the ultrasonic sensor depends on the temperature. Make use of compressor to compress the garbage within. Boundary constraints must be taken into consideration in the source code. For a newly installed bin, sample readings of empty bin to be taken to calculate height of the bin. The hardware setup must use WiFiManager modules to connect to internet through L4 redirection and upload data to cloud storage such as Firebase. Mobile or web application derives data from the cloud and notifies the corporation accordingly. If the bin is either filled over 70% of the capacity of the bin or the duration of the garbage being unattended is 2 days or more, alert is to be given notifying immediate actions are needed.

VI. SYSTEM ARCHITECTURE

Fig 1: System Architecture Design

This system is combination of both hardware components and software components. Google cloud service namely Firebase is used along with the setup for storage and retrieval of data.

a) Software used – Arduino IDE

The Arduino Integrated Development Environment (IDE) is a cross-platform application (for Windows, macOS, Linux) that is written in functions from C and C++. It is used to write and upload programs to Arduino compatible boards, but also, with the help of third party cores, other vendor development boards. We make use of WiFiManager module and firebase module for our system.

Firebase module enables nodemcu to communicate with google cloud firebase and utilize its services. It ensures secured communication of data over the internet since Asymmetric encryption method is followed. The data to be sent is encrypted at client side before transmission using its encryption mechanism making using of unique client id or key. Data transmission is fast and well secured.The data stored at cloud is encrypted again using google's own security mechanism.

WiFiManager ensures reliable network connectivity to wireless network. When the setup is installed for the first time, the board activates access point mode, connecting to which leads us to a captive portal via L4 redirection on a mobile or pc connected to same Access Point (AP). The captive portal should be password protected for enhanced security. In the captive portal, one or more WiFi credentials can be added to which user might want to connect in future. Once done, the board changes its state to default mode attempting to connect to WiFi. If a WiFi is down, it will automatically attempt to connect to other WiFi station using credentials fed via captive portal.The credentials entered is not hard coded onto the board via software code, instead it gets stored in RAM and firmware which isn't accessible to users. This ensures reliable and secured connectivity to the internet.

b) Cloud services used: Firebase

Firebase is a Backend-as-a-Service (BaaS) app development platform that provides hosted backend services such as a realtime database, cloud storage, authentication, crash reporting, machine learning, remote configuration, and hosting for your static files.Database is stored under the format of JSON and to be synchronized with clients in realtime. The cross-platform client is the fundamental platform of this database which all clients share the same resource from Firebase server and it will automatically update when any data is stored of changed. Firebase uses NoSQL type for its database that removes the constraints when interacting with tables, fields. This helps user freely create and decorate database easier. It provides numerous features such as user authentication.

The sensor readings captured from the sensors (ultrasonic sensor, gas sensor, temperature sensor etc) by nodemcu are sent to firebase. The mobile or desktop web applications can fetch the data from the cloud after user authentication check and it can be shown to the end users for monitoring. The user can send appropriate control signal as when required which gets stored in firebase directly. The control commands are read by IoT board and changes can be reflected by sending required control signals to the sensors or devices attached to it.

c) Hardware used

1) Board: NodeMCU

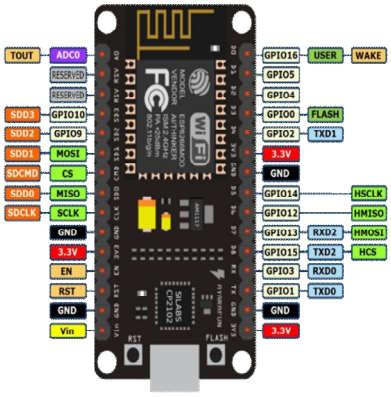

Fig 2: NodeMCU

NodeMCU is an open-source firmware and development kit that helps you to prototype or build IoT product. It includes firmware which runs on the ESP8266 Wi-Fi SoC from espressif Systems, and hardware which is based on the ESP-12 module. The firmware uses the Lua scripting language. It is based on the elua project, and built on the Espressif Non-OS SDK for ESP8266. The sensors are attached to its pin. Analog and digital sensors are attached to analog and digital pins respectively. The board can be programmed using software Arduino IDE in C/C++ to control pins. Data can be written to or read from the pins.

2) Ultrasonic sensor

A special sonic transducer is used for the ultrasonic proximity sensors, which allows for alternate transmission and reception of sound waves. The sonic waves emitted by the transducer are reflected by an object and received back in the transducer. After having emitted the sound waves, the ultrasonic sensor will switch to receive mode. The time elapsed between emitting and receiving is proportional to the distance of the object from the sensor.

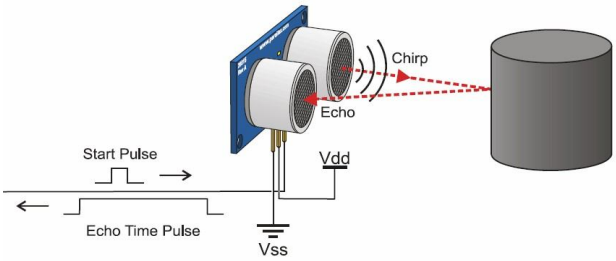

Fig 3: Ultrasonic sensor

Ultrasonic sensors generate high-frequency sound waves and evaluate the echo which is received back by the sensor, measuring the time interval between sending the signal and receiving the echo to determine the distance to an object.

VII. CONCLUSION

This system ensures a healthy and hygienic environment. Improper disposal and maintenance of garbage from public's home and dumping sites lead to pollution and results in various deadly diseases which adversely affects life style of people. This project enables municipal corporation get a fairer idea for timely cleanliness of areas and also helps reach the sites with optimized routes generated which further saves time and fuel. The data collected over time can be studied to plan the schedule for cleansing more efficiently. It helps manage the resources for garbage collection properly. Hence the proposed system is more efficient and cost effective.

VIII. FUTURE ENHANCEMENT

The network reliability can be improvised by providing provision to connect to internet via ethernet as well. More sensors can be implemented and integrated to get further beneficial information out of the system and its environment like GPS for anti-theft. Local storage of data can be maintained for buffering the data from the sensors temporarily in case of network failure.

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