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Energy Efficient Smart Garbage Monitoring System for Smart City using Internet of Things (IoT) & Sensors

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Abstract: Garbage Monitoring System helps to eradicate or minimize the garbage disposal problem also helps to manage unwanted material left over from City, College, home, Society, colonies, Public area etc. This paper presents design and implementation of smart garbage monitoring system using IoT. Monitoring of garbage level only is not sufficient to make city environment clean odour free. Because if level of garbage bin remain below threshold value for long period then it causes odour, and it is unhygienic to people living nearby. To avoid this we need to monitor gases generated at garbage bin. One of the objectives of design is sensing unit at garbage bin has to be battery operated. So that it can be portable and easy for connecting to garbage bin when there is no power supply readily available.
Keywords: IoT, Garbage Monitoring System, Wi-Fi.

I. INTRODUCTION

The proposed Smart Garbage monitoring system for Smart City is Energy efficient and based on the Internet of Things (IoT) & sensors. In the proposed system, at dust bin the Node Mcu development board with inbuilt Wi-Fi is used for accessing information about dust been level and gases generated by IR sensor and gas sensor. At main controlling station ESP8266 is used to continually access garbage bin data which is useful for machine learning and future prediction. If the level of garbage in bin goes above threshold value then main system alarm and send information to collection vehicle. Data contains bin level information and gases generated with date and time. Anyone can view this data as it is on cloud. In most of system which are develop yet sends commands when bin level goes above. There is communication between workstation and sensor node. The workstation or server performs computation on data which it receives. Based on result of computation alert message will be sent to collection vehicle.

II. LITERATURE SURVEY

Prof. Dr. Sandeep M. Chaware et al. [3] presents Garbage Monitoring system, which monitors the garbage bins and informs about the level of garbage collected in the garbage bins via a web page. The System Architecture, in which system uses ultrasonic sensors placed over the bins to detect the garbage level and compare it with the garbage bins depth. The proposed system uses Arduino family microcontroller. The LPC2131 microcontrollers are based on a 16/32-bit ARM7TDMI-S CPU with real-time emulation, LCD screen, Wi-Fi modem ESP8266 supports APSD for VoIP applications and Bluetooth co-existence interface for sending data and a buzzer, GSM used to send message to the garbage depot if the Garbage Can exceeds the set threshold level. Ultrasonic Sensor sends out a high-frequency sound pulse and then times how long it takes for the echo of the sound to reflect back. P.R. Naregalkar et al. [4] developed IoT Based Smart Garbage Monitoring System, in which dustbins are interfaced with microcontroller based system having Ultra sonic sensors with wireless systems. These wireless systems central system showing current status of garbage, on mobile web application with connected via Wi-Fi, as shown in fig 2. This proposed system implemented using ultrasonic sensor also known as transceivers when they both send and receive, also work on a principle similar to radar or sonar, which evaluate attributes of a target by interpreting the echoes from radio or sound waves respectively, microcontroller AT89S52 was used and designed with static logic for operation down to zero frequency and supports two software selectable power saving modes and Wi-Fi module Espressif Systems' Smart Connectivity Platform is used, which provides a set of high performance, high integration wireless SOCs, designed for space and power constrained mobile platform designers. Lilyan Anthony et al. [5] proposed a model in which the collection of garbage is made real time. A network is established using wireless sensors, which are placed in the garbage bin, set at a particular level. Sensors will send a signal to the nearest vehicle driver if the level of garbage is crossed to set level. Figure shows the Architectural Diagram, which consists major three modules; Sensor Module, in which sensors are used to sense the garbage

levels once and connected to the Arduino board, Communication Module, in which Bluetooth is used for communication between the sensors and Arduino Uno board, and last module is Analysis and Monitoring Module, in which collected is sent to the admin for analysis. Kalyani Ghute et al. [6] presents IOT Based Smart Garbage Monitoring and Air Pollution Control System, in which system monitors the garbage bins and informs about the level of garbage via a web page. Figure 4 shows the block diagram of proposed system. In this system two ultrasonic and two gas sensors are used for level of garbage and harmful gases in the air respectively. Sensors are connected to the AVR family microcontroller (ATmega328) which is interfaced with LCD display which shows the status of bins and Wi-Fi module (ESP8266) is used to transmit data for webpage applications, which is a self-contained SOC with integrated TCP/IP protocol stack.

III. PROBLEM IDENTIFICATION.

From literature survey it is clear that all electronic circuitry at Garbage bin use external power supply. If power failure occurs there is no provision for system operation. But we know that external power supply is not readily available at all the places. Second problem is if we connect 230v supply to electronic circuitry then people are scared drop garbage in bin. So there is need of system which consumes less power and should be battery operated as well as compact in size.If level of garbage bin remain below threshold value for long period then it causes odour, and it is unhygienic to people living nearby .It decomposes, attracts flies and vermin, and has the potential to add biological oxygen demand (BOD) to the leachate So we need system to detect gases generated due to decomposition of wet garbage, food etc. From the Literature Survey we found effective methods which are useful for smart garbage management. The garbage monitoring system should have database with parameters of interest like Bin level and gases density with time and date. From previous data we can predict amount of garbage generate on particular day, month, festival ect. This is useful as we aware of garbage quantity garbage depot can prepare their system for decomposition. Another point is garbage level must be visible to all online for their information.

IV. SYSTEM ARCHITECTURE.

The propose system consist of Sensor Node with Wi-Fi internet connectivity, Thing speak cloud and Workstation control unit.

A. Sensor Node

As shown in fig.1 the sensor Node is consist of IR level sensors and GAS sensor MQ4 low power NodeMCU and Battery. The main controlling unit is low power ESP8266 based NodeMCU . The core processor ESP8266 in smaller sizes of the module encapsulates Tensilica L106 integrates industry-leading ultralow power 32-bit MCU micro, with the 16-bit short mode, Clock speed support 80 MHz, 160 MHz , supports the RTOS, integrated Wi-Fi AC/BB/RF/PA/LNA, on-board antenna.

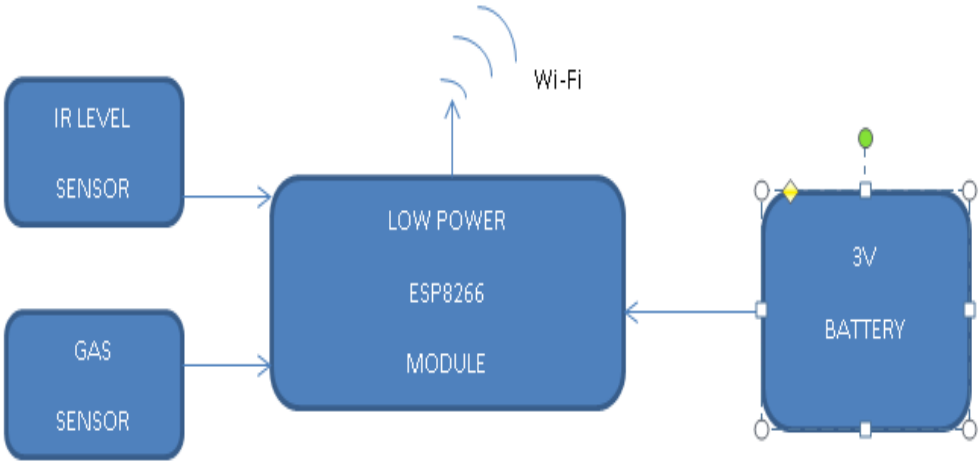

Fig.1 Block diagram of sensor Node

The module supports standard IEEE802.11 b/g/n agreement, complete TCP/IP protocol stack. ESP8266 is high integration wireless SOCs, designed for space and power constrained mobile platform designers.

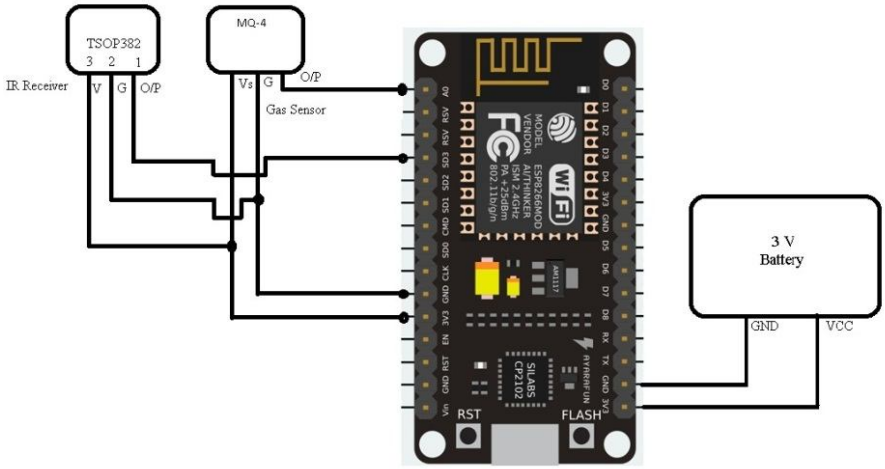

Fig. 2 Connection diagram of sensor node

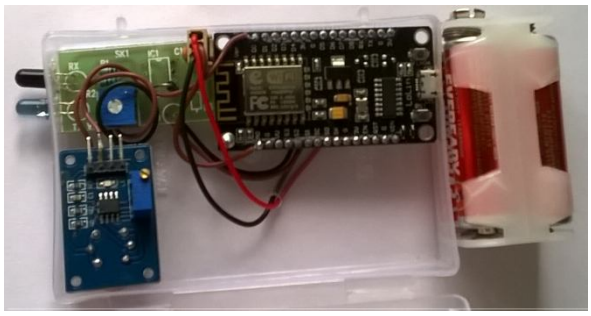

Fig. 3 Hardware Implemented Sensor Node

B. Workstation Control Unit

The workstation control unit reads the real time data from cloud. This unit is responsible for controlling garbage collection vehicles. As shown in block diagram Workstation unit consist of Wi-Fi transceiver ESP8266, Computer, Arduino Nano development board, GSM module, Power supply.

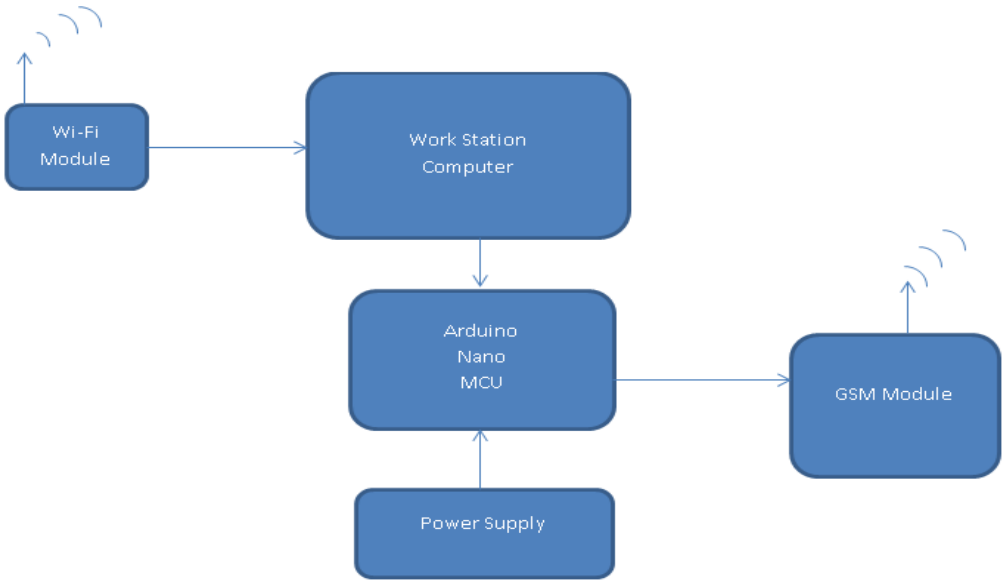

Fig. 4Block diagram of workstation control unit

The Wi-Fi module reads the data from cloud and sends it to Arduinonano development board. Ardiuno development board is used to interface GSM modem for SMS based communication purpose with collection vehicle driver. When garbage bin level exceeds set threshold value then ardiunonano sends message to garbage collection vehicle driver and society secretory for information. Driver will get location information of garbage bin through this message.

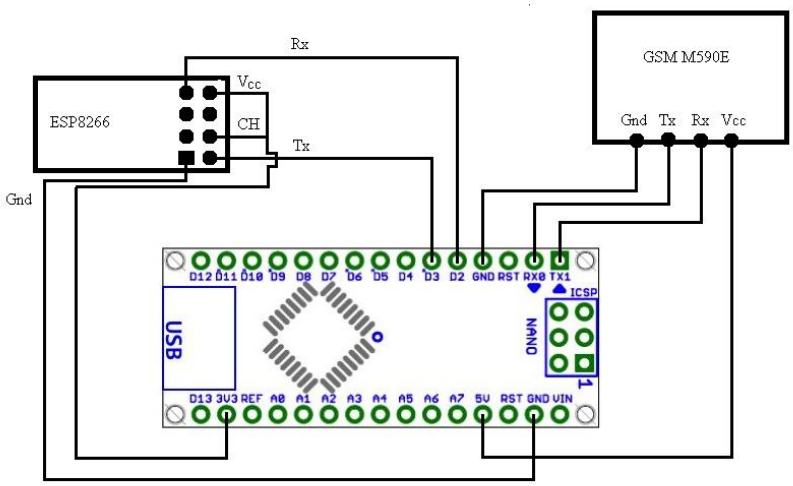

Fig. 5 Connection Diagram of Workstation control unit.

The center of data base is Thing speak cloud which is product of math works. Garbage Bin data is continually update in cloud. Using thing speak API data is visible in real-time graph.

Fig. 6 Hardware implemented Workstation control unit.

V. RESULTS.

Smart collection bin graphs are visible from internet. For each garbage bin Level and gases generated are visible as shown in figure bellow fig 7. When the garbage in bin goes above threshold value SMS received on two registered number. One message is received by registered userand other message is for garbage collection vehicle driver. The message text contains garbage bin number for identifying its location. Garbage level graph shows level with respect to date and time

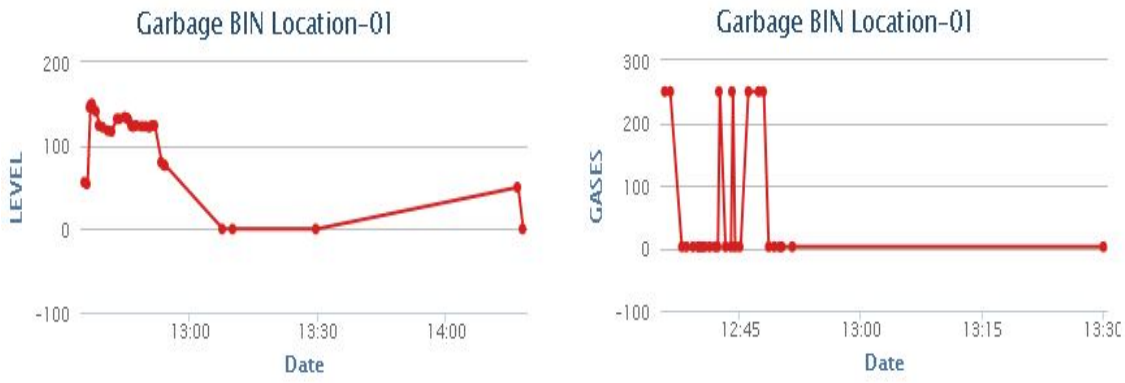

Fig.7 Graph of Bin Level and Gases with time and date

VI. CONCLUSION

The system design and implemented here for monitoring of garbage bin can be very much useful for collection decomposition garbage depot. Some of the day the garbage bin gets full very fast that's depends upon many factor like in festival season or Sunday etc. So the graph obtained from our system is helpful for prediction how much garbage can be create on particular day. By analyzing different garbage bin data we can get information about which area create more garbage.

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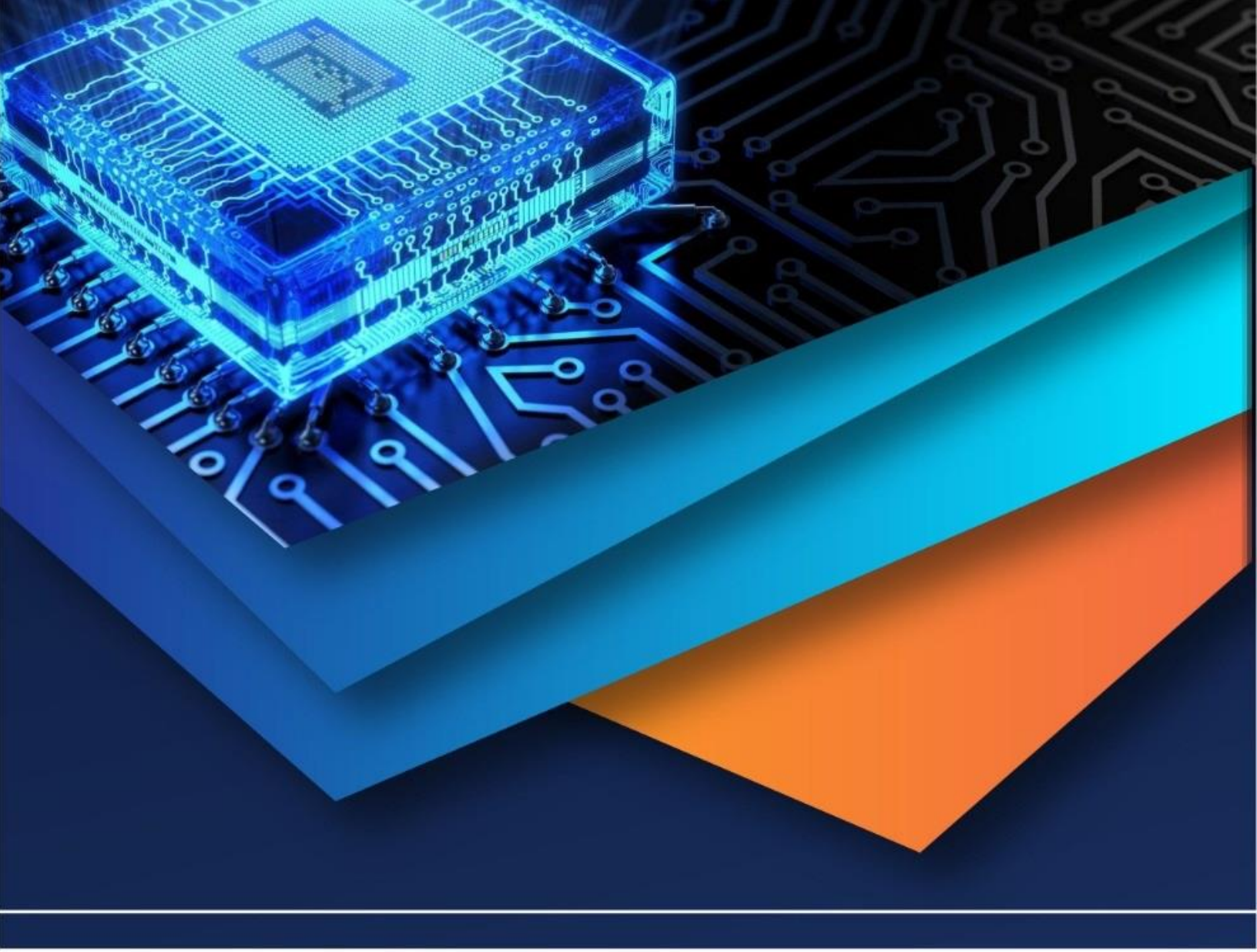

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