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GSM based Garbage and Waste Collection Bins Overflow Indicator via IoT

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Abstract: ***Now a days, waste management is a huge problem in the world. Key issue involved in waste management is waste collection within time, without overflowing the dustbins in public places. This paper presents an energy efficient waste management systems using IoT. This system measures the level of dust bin for every 30 minutes and sends the level to the cloud or database. Whenever the dustbin is full, it will send the location (longitude and latitude values) of dustbin to nearest garbage truck driver's application. An application is developed for showing dust bin level and to track the location of the dust bin for truck drivers. This system will operate for every 30 minutes to increase the battery life and remaining time system will be in sleep mode. Wi-Fi technology is used for sending the dustbin level to database.***
Keywords: IoT, Waste management, Wi-Fi, location, database.

I. INTRODUCTION

As Years going on, Population and Wastage Generation are keep on increasing. India generates more than 1,00,000 metric tons of wastage/day. As discussed in [1], Urban india generates 31.6 million tons of wastage in 2001, 47.3 million tons in 2011, 71.15 million tons in 2021, 107.01 million tons in 2031 and 160.96 million tons in 2041. Figure 1 explains about the population and waste generation in Urban india from year 2001 to 2041. Main problems with waste management is overflowing of dustbins at public places which causes emission of gases from the dustbins and it leads to many health problems. There are four types of wastages solid, liquid, hazardous and medical. Storing of these wastage leads to emission of carbon dioxide and methane gases. A huge amount of money is spent for waste collection and seperation process.

In [2], explained smart cities developed by doing different services like Structural health, Waste managemnet, Air Quality, Noise monitoring, Traffic congestion, Smart parking, city energy consmpution and Smart lighting etc. Waste management is one of the main important service has to be done to develop smart cities.

Now a days waste collection system spending so much of effort and money to collect the waste form each home and each dustbins. in each and every aspect world technology is improved so, waste management system also has to be improved. Many researchers already worked on waste management system and proposed many techinques to elemenate waste management problems. These techniques are explained in section II.

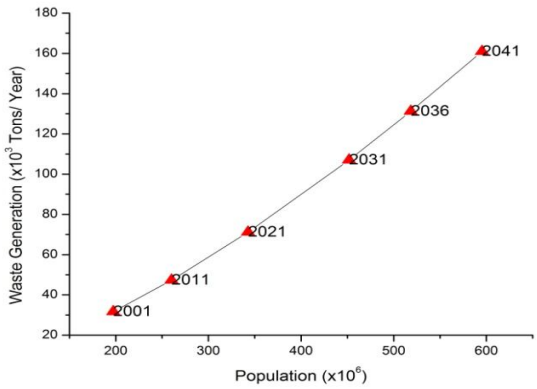

Fig. 1 Graph for Population vs Waste Generation from years 2001 to 2041

This paper structured as 4 sections: Section II explains Literature Survey. Section III discusses about proposed system, hardware modules and working. Section IV gives conclusion of the paper.

II. LITERATURE REVIEW

In IoT Enabled Dustbins [1] by authors sahil mirchandani, sagar wadhwa, preeti wadhwa, Richard Joseph have proposed a system contains ultrasonic sensor for measuring dustbin level, Air quality sensor is used to determine gas emissions, RFID used for opening the lids of dustbins, measures the weight of wastage for every user and sends all these data to cloud. In this system authors used GPS for finding location of the dustbins but in public places the location of dustbins will be static so, no need for use GPS and the total system can be ruggedized to safeguard the modules.

In Smart Waste Management using Internet-of-Things [3] by authors Gopal Krishna syam, Sunilkumar S Manvi, Priyanka Bharti have designed a system with ultrasonic sensor for measuring dustbin level and sends data to server using internet. The same system also proposed by efficient waste collection system [4] by authors saurabh Dugdhe, Pooja shelar, Sajuli jure and Anuja apte.

In IoT based solid waste management system for smart city [5] by Krishna nirde, Prashant S. Muley, Uttam M.cheskar used ultrasonic sensor, PIC and Arduino controllers. PIC is used for data collection from sensor, send it to Arduino using RF transmitter and Receiver module. Arduino receive the data and uploaded it to server. This system is mainly used where Wi-Fi is not available at dustbins but it takes more power compared to other techniques.

In [6], the authors have designed a smart waste bin for smart waste management using IoT. The designed system uses strain gauge load cells to measure the weight of wastage and tested this load sensor using brass weight set with fiber waste-bin 60L, stainless waste-bin 40L, iron sheet waste-bin 45L and plastic waste-bin 30L. Similarly HC-SR04 used for wastage level measurement and also tested by four kinds of waste bins. Weight and level of the bins are sending to server using GSM technology. Mobile application and web server created for monitoring this information.

In [7], the main objective of proposed system is segregation of different types of wastes like plastic, biodegradable and metal. The waste is dropped at the sensor panel, it segregates the type of waste with help of different sensors and dumped into the corresponding segment. It has gas and bacteria sensor for detection of gas emissions and developed a Odour controller for minimizing the unpleasant Odour. Level of dust-bin is measured and sends to server using STM-32 controller and Wi-Fi module.

In [8], authors designed a system for checking the garbage container status and sending this status to server. System contains a ZigBee network for Data acquisition from sensors, data processing by MQTT broker to the main server and Telegram Bot is used for used for sending notification to truck drivers. A Gateway is designed for collecting data from ZigBee coordinator and sending it to MQTT broker.

From the above Literature review, all researches explained about measuring the dust-bin level, detection of gas emissions from the dust-bin, weight of the dust-bins, segregations of waste and this data sends to server using various communication techniques like Wi-Fi, GSM and ZigBee. Our proposed system measures the dust-bin level sends the data to application and server with less power consumption. Our system also creates a provision for tracking the dust-bin for the garbage vehicle driver using GPS technology.

III. PROPOSED SYSTEM

The main objective of this paper is designing a waste management system with less power consumption and providing facilities like sending notification to garbage vehicle driver application when bin full, tracking dust-bin using app for fast cleaning of dust-bins.

The Block diagram of proposed system is shown in figure 2. It consists:

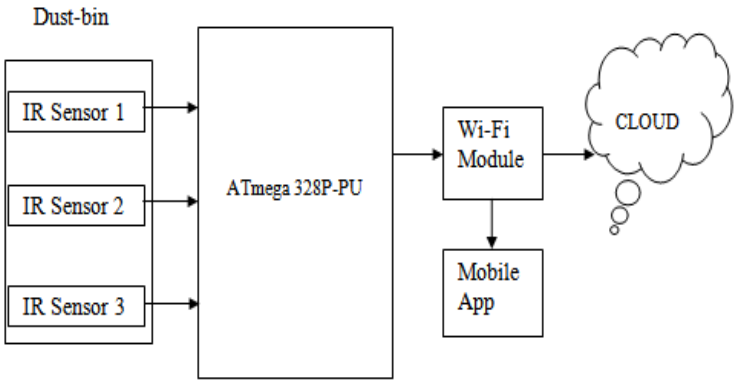

Fig. 2 Block Diagram of proposed system

A. IR Sensor

Proposed system consist of three IR sensors to detect waste in dust-bins at three levels i.e. LOW, MEADIUM and FULL. IR sensor has two parts one is transmitter and other receiver, transmitter is placed at one side of bin and receiver is placed exact opposite to transmitter. IR sensor placement and levels are shown in figure 3.

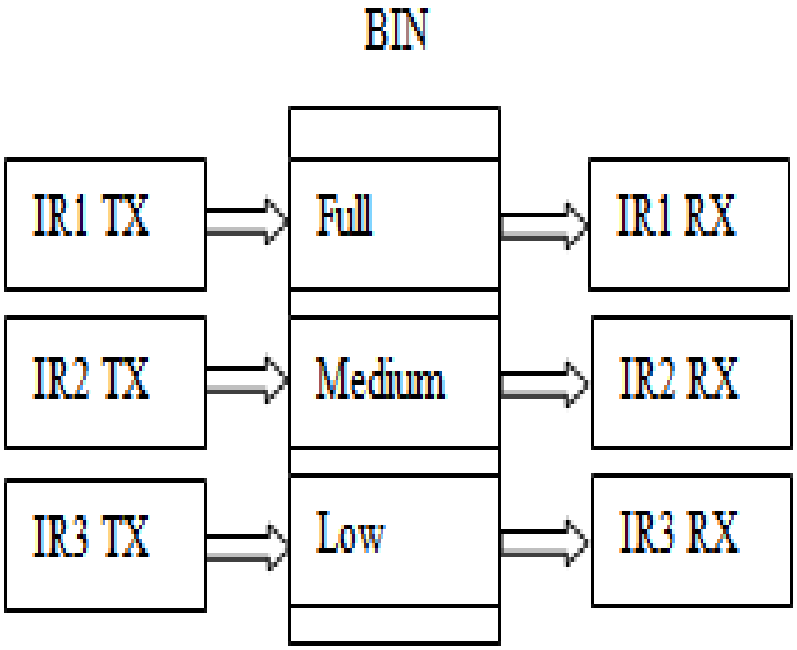

Fig. 3 IR sensor placement and measuring levels

B. Wi-Fi

ESP-8266 Wi-Fi module is used to send data from controller to web server and mobile application. Web page and mobile application is created for monitoring the level and track the dust-bin route. Wi-Fi module will connect to nearest router by providing username and password of the router.

C. ATmega 328P-PU

ATmega 328P-PU is the controller used to collect data from IR receiver, checking whether dust-bin is filled or not and sending static GPS coordinates to webpage and mobile application using Wi-Fi module when dust-bin is full. It will keep the total system in sleeping mode whenever required. An algorithm is created in controller for checking the nearest free vehicle and sending notification to that vehicle when dust-bin is full.

D. Web page and Mobile App

Web page and mobile app is created for showing the level of dust-bin and to track the location of dust-bin using Google map.

The complete process of the proposed system is shown in figure 4. Initially IR sensors measures the waste level, sends the waste level to server using controller and Wi-Fi module. Controller will check for dust-bin is full or not and if the dust-bin is full, it will find the nearest vehicle and sends the longitude and latitude values of dust-bin to vehicle drivers mobile application. If the dust-bin is not full, controller kept the total system in sleep mode for 30 minutes to reduce the power consumption and after 30 minutes system will start from initial stage. To reduce the power consumption and cost of the system, GPS module is not used and the longitude and latitude values of dust-bin are kept fixed because the dust-bin used in public places is static. Google map is linked to the web page and mobile application to track the location of the dust-bin using longitude and latitude values. After sending notification to garbage vehicle driver, Driver will track the dust-bin and clears it. Then the IR sensors detect no waste in dust-bins and sends signal to controller like process is completed. Controller kept the total system in sleeping mode for 30 minutes and start again after completion of time period.

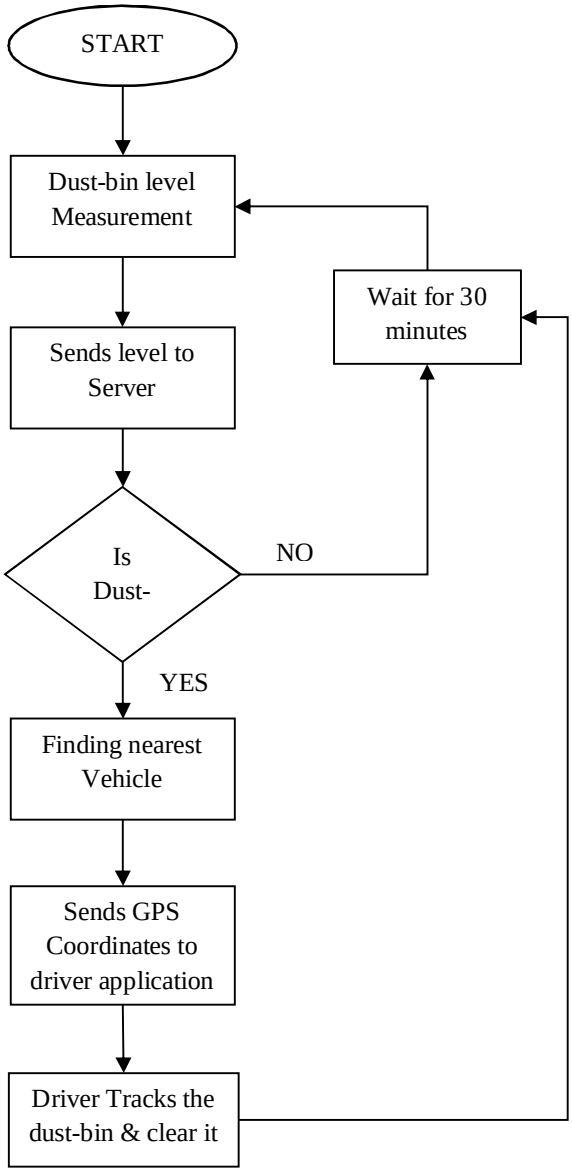

Fig. 4. Process flow

The above complete process flow can be explained in four steps

1) Level measurement
2) Data acquisition
3) Data processing
4) Tracking.

IV. CONCLUSIONS

In this paper we proposed a system to collect the waste in dust-bins with in time to avoid overflow of dust-bins in public places. The system is designed mainly to use less power consumption by keeping system in sleeping mode for 30 minutes and easy way of interaction between the garbage vehicles with dust-bins. Also this system uses pre-fixed location of dust-bins to reduce the power consumption and cost of the system.

V. FUTURE SCOPE

In IoT technology, energy efficient communication technologies are playing a key role. Communication technologies like LoRa, LoRaWAN, sigfox and NB-IoT use very less power to transmit the data long ranges. In the proposed system, Wi-Fi can be replaced with above communication technologies to reduce the power consumption.

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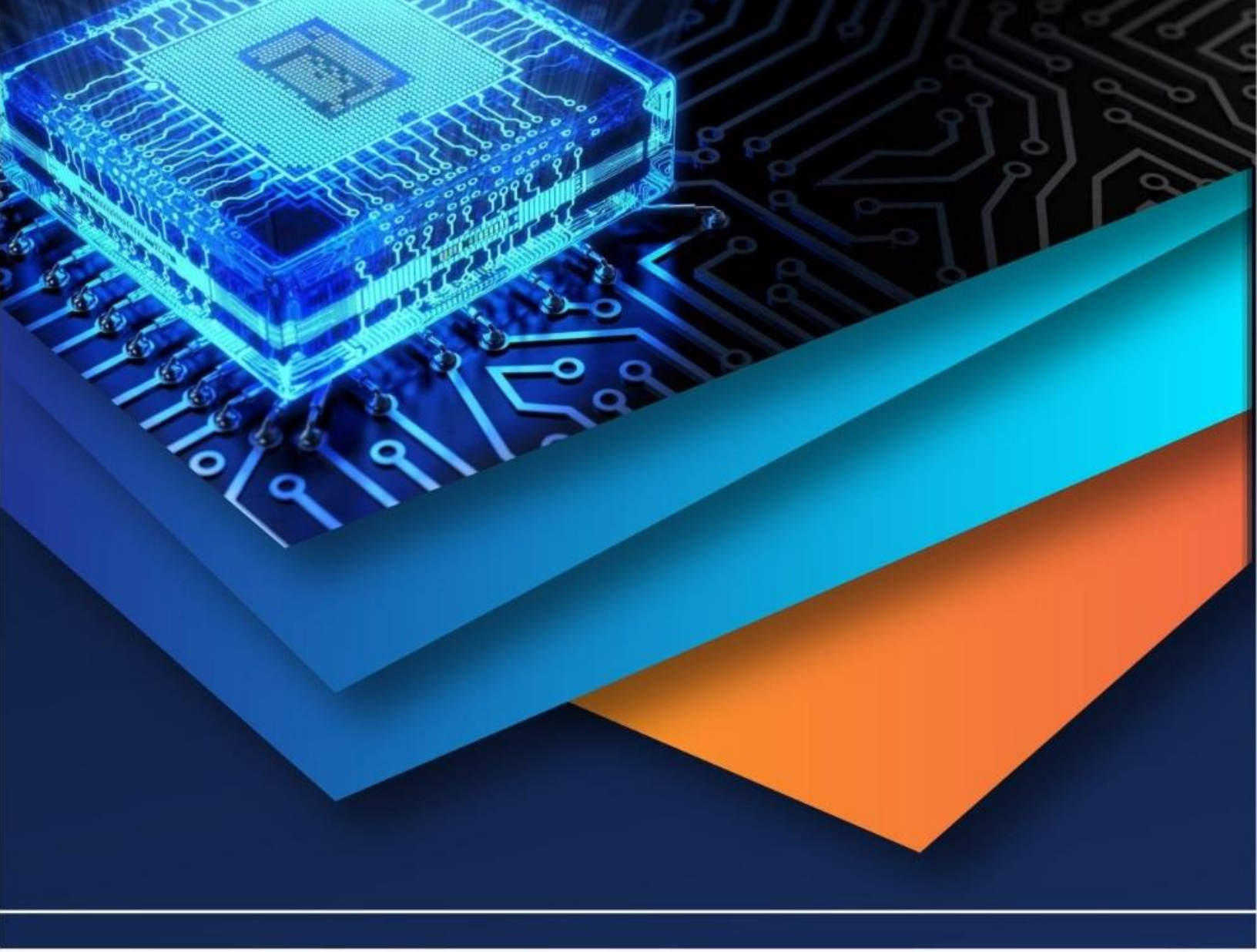

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