IoT Based Real Time Waste Management System

Siddhanna Janai[1], Pallavi C R[2], Monisha M[3], Meghana K S[4], Varamahalakshmi R[5]
Maharaja Institute of Technology Mysore, Karnataka-571477

(jsiddhub@gmail.com)
(pallavicr51@gmail.com)
(monisha0477@gmail.com)
(Meghanasshekar15@gmail.com)
(Varuraj1997@gmail.com)

Abstract— Waste management is one of the major problems that the world is facing and it is the primary challenge for the developing countries like India. The key issue in the waste management is the conventional way of garbage dumping into the garbage bins placed at public places, as these garbage bins gets overflowed before the commencement of the next cleaning process. This leads to the menace such as bad odor & lack of cleanliness. Which results in the spread of various diseases. To address this issue an IOT based smart garbage monitoring and collection system for proper waste management is developed. This paper proposes a real time system for garbage clearance by giving an alert signal to the municipality for instant cleaning of dustbin with proper verification based on the level of garbage filling. This process is aided by the ultrasonic sensor, which is interfaced with ESP8266(NodeMCU) to check the level of garbage filled in the dustbin and sends the alert to the mobile. This system also contains a humidity sensor that senses the wet waste dumped into the dustbins and acts as an alert for dry and wet waste segregation.

Keywords- IoT, ESP8266, Ultrasonic sensor, humidity sensor, NodeMCU, BlynK, GSM, Raspberry pi.

I. INTRODUCTION

Waste Management is the process followed to manage wastes starting from its generation to final disposal. This involves generation, segregation, collection, transportation, treatment, recycle and / or disposal of waste together with monitoring and regulation. Waste collection procedures followed varies among different countries and regions. Domestic waste collection and disposal services are provided by local government bodies such as municipal corporations.

Curbside collection of garbage is the most common method in developing and underdeveloped countries. At present cities with rapid development experience exhausted waste collection services, inadequately managed and uncontrolled dumpsites. In the existing system, the garbage is collected by the municipality servants on the scheduled routine basis i.e. weekly or 2-3 times within the month. As we see many times that garbage bins are placed in the public places in the cities are overflowing due to increase in the waste every day. Also, wet and dry wastes are

dumped into the same bin most of the times. Due to this, the garbage shrinks and produces the bad odor which will tend to cause pollution and can spread diseases. To overcome these difficulties this work describes the development of an Internet of Things (IOT) based smart garbage management system. With the rapid technological developments' internet has become integral part of human life [1]. IoT is the extended version of the internet, which facilitates the communication between physical objects in real time with or without the human interference.

Some of the recent works carried out related to smart garbage management system are discussed below.

N. S. Kumar *et al.* proposed an IOT based smart garbage management system using RFID and Arduino Uno. An android application is developed for remote monitoring of the garbage collection. The system was concentrated only on solid/dry waste management [1]. B. B. Deepali and R. Preethi have developed a real time garbage monitoring system using ATMEGA controller and Wi-Fi module based on IoT. Cost of system implementation was high [2]. A. Singh *et al*. proposed a work which utilized Infrared sensors to collect real time information from the waste bins & the Raspberry Pi2 Development Board is used to communicate this information to the municipal corporation [3]. F.Fulianto *et al*. presented a system that determines whether the garbage bin is full or empty. Wireless mesh network is used here to communicate the data to the monitoring authority [4]. It can be noted from the previous works that the focus was only on solid/dry waste management using IoT. Thus, the system described here addresses not only dry waste management but also dry & wet waste segregation.

II. PROPOSED SYSTEM

The main objective of the proposed system is to involve IOT technology to the current waste management scenario. That includes, Real time monitoring of the waste along with wet and dry waste segregation alert system. Fig.1 shows the Block diagram of proposed system.

Basically, there are five main components of the whole system, Power supply part, sensing part, processing part, uploading part, and the alerting part. An ultrasonic sensor senses the garbage level and accordingly sends the signals to the microcontroller. The moisture sensor is also interfaced with the

microcontroller which is used to indicate the wet waste dumped into dustbin. ESP8266 Microcontroller is the main Module in this project. The ESP8266 is Wi-Fi microchip with full TCP/IP stack.
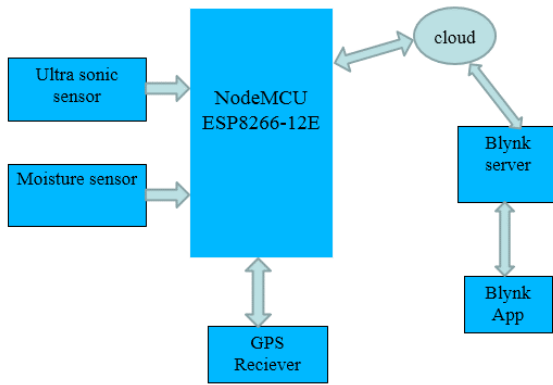

Fig.1 Block diagram of proposed system

It is basically a Wi-Fi module which is also working as a microcontroller ESP8266 plays a very important role in reducing the hardware of the system. GPS Module is a navigation device it will indicate the location of bin where garbage is filled. The respective authorities can see the bin status like whether the bin is empty or bin is filled, whether wet waste has been dumped and location details of garbage filled bin in the Android application.

A. *ESP8266-12E:*Esp8266 Wi-Fi Module is a low power consumption UART-Wi-Fi module designed especially for mobile devices and IoT applications, user's physical device can be connected to a Wi-Fi wireless network, internet or intranet communication and networking capabilities. The module supports standard IEEE802.11 b/g/n agreement, complete TCP/IP protocol stack.

B. *Ultrasonic Sensor HC-SR04:*Ultrasonic ranging module HC - SR04 offers   a 2cm - 400cm non-contact measurement function, the ranging accuracy could reach up to 3mm. The building modules includes ultrasonic transmitters, receiver and control circuit. Ultrasonic sensor is used to detect the level of garbage filled by interpreting the reflected signal from the garbage. The equation which governs the level of garbage filled is given by:

*distance=high level time * velocity of sound/2*

C. Humidity Sensor: This module is able to detect the amount of humidity. Using the built-in comparator, the output will be either digital(high/low) or analog (0v-5v) depending on the severity of moisture. In this work, it is used to detect whether any wet waste is dumped into the bin kept for dry waste.

D. *GPS:* Global Positioning System **(GPS)** is a navigation system based on satellite. It is mainly used in positioning, navigation, monitoring and surveying applications. GPS is

been utilized here for real time location finding of garbage bins.

III. SOFTWARE REQUIREMENTS

The proposed system requires Arduino IDE and BlynK Application software.

A. *ARDUINO IDE: "*The Arduino integrated development environment (IDE) is a cross-platform application. Arduino IDE comes with a board management module where users can select the board they want to work [5,7]". The Arduino IDE is used here to program the ESP8266 Wi-Fi Module.

B. *BlynK App:* Blynk is the application designed for the Internet of Things. Blynk is a platform which can be used with iOS and android applications to control Arduino, Raspberry pi etc.
- It is used here to control hardware remotely and send the sensor data to the server display placed at the municipal corporation [8].

IV. PROCESS FLOW

Process flow is described with the help of process flow chart shown in Fig.2. It involves following steps:
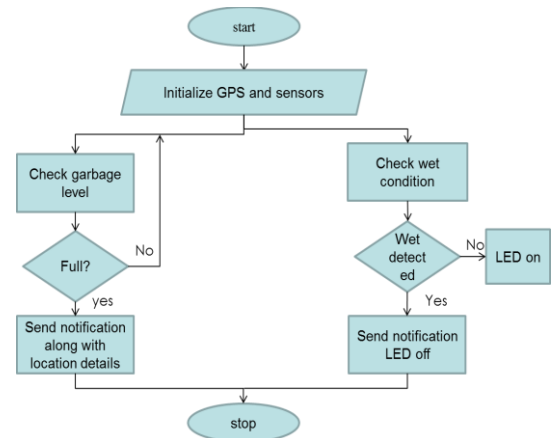

Fig 2: Process Flow Chart

- When The system is powered on, GPS and sensors are initialized.
- Garbage level will be measured by the ultrasonic sensor placed on top of the garbage bin.
- The garbage level will be communicated to the remote server (Blynk app). The garbage level displayed on to the mobile screen.
- If the garbage bin is full, then a notification is sent to the server regarding location of the bin and other details. Keep monitoring the garbage level if bin is not full. Based on this information the authority can take necessary action such that the garbage is collected as soon as possible ensuring no overflow of garbage.
- On the other hand, moisture sensor placed at the bottom of the bin will continuously measures the amount of moisture

content in the bin.

- If the moisture content exceeds the set threshold value, the server is notified by turning on of an LED on the screen. The person on ground will take necessary steps to separate dry and wet waste. Also, garbage collecting personnel can educate the people in that locality to not put wet waste in dry waste bin.

V. RESULT

The system operation in different conditions is captured in the following figures.

- Fig.3 shows the garbage bin model along with the level of garbage (Zero level as no garbage put inside) and bin location details through Blynk app.
- Figure 4 shows the level of the garbage bin is 600 indicting that the bin 60% full.
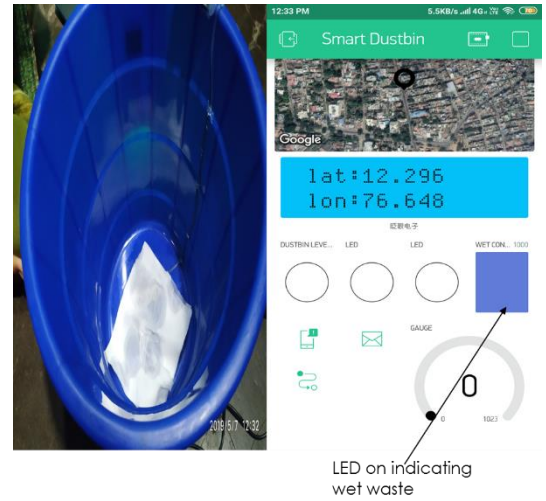- Figure 5 shows the wet waste indication through the LED on screen.
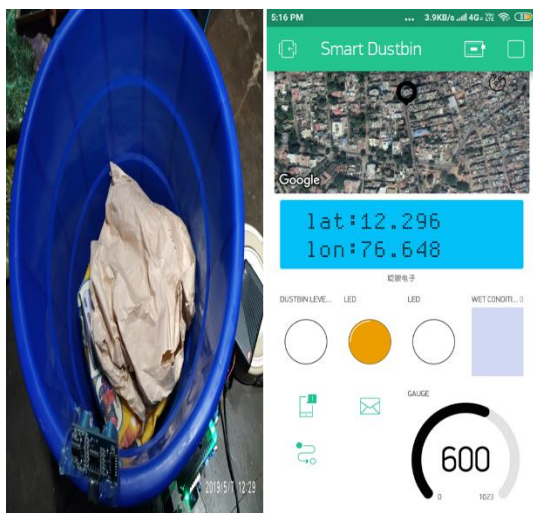

Fig.3 Proposed garbage bin Model and Blynk app.

Fig.4: garbage bin when 60% full.

Fig.5 Wet waste indication

VI. CONCLUSION

The proposed work has achieved the stated objectives. i.e., the solid waste management and wet waste alerting through IoT. The proposed system can be implemented in full fledge for monitoring the status of bin and it will give the alert commands to maintain public cleanliness. The designed system is portable so as to make it easy to access, configure, run and maintain. Also, the system assures the cleaning of trash cans once the garbage level reaches its maximum limit and can indicate the wet wastes dumped into the bins. This helps in taking prevention measures for separating the waste. It ultimately helps to keep cleanliness in the society. Therefore, the smart garbage management system makes the garbage collection more efficient.

VII. FUTURE SCOPE

A list of future works which can be performed on this waste management system is listed as follows:

- The system can be enhanced to measure gaseous pollutants.
- This system can further advanced by using robotic arm for automatic collection of garbage.
- Solar energy can be used as alternative to electricity by attaching solar panels to the bins.

REFERENCES

[1]. N. S. Kumar, B. Vuayalakshmi, R. J. Prarthana and A. Shankar, "IOT based smart garbage alert system using Arduino UNO," 2016 IEEE Region 10 Conference (TENCON), Singapore,2016, pp.1028-1034. doi: 10.1109/TENCON.2016.7848162.

[2]. B B Deepali and Priti Rajput, "IOT Based Smart Garbage Alert System using Arduino UNO", IJRCCE, Vol. 6, Issue 6, June 2018.

[3]. Abhimanyu Singh, Pankhuri Aggarwal, Rahul Arora, "IoT based Waste Collection System using Infrared Sensors", 2016 5th International Conference on Reliability, Info com Technologies and Optimization (ICRITO) (Trends and Future Directions), Sep. 7-9, 2016, AIIT, Amity University Uttar Pradesh, Noida, India.

[4]. F achmin F olianto, Yong Sheng Low, Wai Leong Yeow, "Smartbin: Smart Waste Management System",2015 IEEE Tenth International Conference on Intelligent Sensors, Sensor Networks and Information Processing (ISSNIP) Demo and Video Singapore, 7-9 April 2015.

[5]. K.Harika, Muneerunnisa, V.Rajasekhar, P.Venkat L.J.N SreeLakshmi, "Iot based smart garbage monitoring and alert system using ArduinoUno", IJIRCCE, 2018.

[6]. Sudharani Ashok Ghadage and Neeta Anilkumar Doshi, "Iot based garbage management system: A Review", IJIACS, ISSN 2347 – 8616 Volume 6, Issue 11 November 2017.

[7]. https://www.arduino.cc/en/Guide/HomePage

[8]. https://docs.blynk.cc/#intro

Authors:

Siddhanna Janai has received his master's degree in the area of Industrial Electronics from JSS Science & Technology University, Mysuru, India. His research interests are in Internet of Things, Speech Recognition, Speech Synthesis and Digital Image Processing. Since 2018, he is working as an assistant professor in the Department of Electronics and Communication Engineering at MIT Mysore, Karnataka, India.

Pallavi C R Currently perceiving her under graduate degree in Electronics and Communication Engineering at MIT Mysore, Mandya, Karnataka, India.

Monisha M Currently perceiving her under graduate degree in Electronics and Communication Engineering at MIT Mysore, Karnataka, India.

Meghana K S Currently perceiving her under graduate degree in Electronics and Communication Engineering at MIT Mysore, Karnataka, India.

Varamahalakshmi R Currently perceiving her under graduate degree in Electronics and Communication Engineering at MIT Mysore, Karnataka, India.