IJCRT.ORG ISSN : 2320-2882

INTERNATIONAL JOURNAL OF CREATIVE RESEARCH THOUGHTS (IJCRT)

An International Open Access, Peer-reviewed, Refereed Journal

Apt Bin: Smart Garbage Monitoring System Using IoT

[1]Akshaya Ramanathan, [2] Ramita Shinde, [3]Rutuja Phatak, [4]Rushikesh Nikam

[1 2 3]Student, [4]Guide

[1 2 3 4] Department of Computer Engineering,

[1 2 3 4] New Horizon Institute of Technology and Management, Thane, India

Abstract: The population in India is increasing day by day and at the same time, the garbage produced by us is also growing at a similar rate. We all have become very busy in our daily lives and we spend very little time being concerned about our environment. An overflowed garbage bin creates an obnoxious smell and causes pollution which may lead to severe health issues. Garbage Management has become a hectic issue as BMC fails to collect garbage from time to time. The traditional way of monitoring the garbage manually is a cumbersome process that requires more time, human effort and resources which is not compatible with present-day requirements. It can be easily avoided with the present technologies. We as humans always prefer automatic systems to make our life simpler rather than using manual systems. Using the concept of the Internet of Things (IoT), we can develop a Smart Garbage Monitoring and Segregation System which would result in less manpower, low fuel cost and improved cleanliness. The proposed system can be the first step towards a clean country.

Keywords **- Arduino Nano, IR sensor, Moisture sensor, Ultrasonic sensor, WIFI module ESP 8266, IoT, 2x16 LCD screen, DC Motor, Garbage Monitoring, Segregation.**

I. INTRODUCTION

The population of the nation is growing exponentially as well as the waste generated by the people. People are less aware of waste management. Due to less time and inefficient efforts, there is mismanagement in the garbage disposal system. Overflowed trash leads to spilling and littering all over the area causing an unpleasant smell and an increase in the number of diseases. This causes a lot of insects and mosquitoes to breed on it. This degrades the standard of living. With evolving technologies, these systems can be used to enhance human life. IoT or the Internet of Things refers to connecting the hardware and software, which helps in communicating and exchanging data among themselves without any human intervention.

A basic need to keep our surroundings clean is a dustbin, so as soon as it gets filled up, it should be emptied to avoid any diseases. Here, we are going to propose a system for the monitoring and segregation of waste. We will use a combination of IR, Ultrasonic, and Moisture sensors for this system. A plank will be placed on the dustbin where you would put the garbage. The IR sensor will sense the garbage and the moisture sensor will sense if the waste is dry waste or wet waste. Depending on what type of waste it is - dry or wet, the motor attached to the plank will be rotated with the help of a motor driver and thus the dry waste will fall on the dry waste side while the wet waste will fall on the wet waste side. This will help in the segregation of waste. The Ultrasonic sensor placed on top of the bin will continuously monitor the bin and send information to the local authority. The bin should be emptied as soon as the garbage in the bin reaches the set threshold level. The concepts of IoT, when used in the right way, can be used to make a better environment for people to live in. The unsanitary conditions and the growth of bacteria in the city can be eliminated. A minimum number of smart bins can be used around the whole city to ensure a cleaner environment. Through an android app, we can get real-time information about the status of the garbage. This proposed system will help in resource optimization. It will effectively reduce human effort.

II. LITERATURE SURVEY

Gaikwad Prajakta, Jadhav Kalyani and Machale Snehal proposed a system where a camera will be placed at every garbage collection point and a load cell sensor would be placed at the bottom of the bin. The camera will take continuous snapshots of the bin. The snapshots from the camera and the weight of the load sensor are then compared to the set threshold level. The comparison is done with help of a microcontroller. After analyzing the image, we get an idea about the level of garbage in the can, and from the load cell sensor, we get to know the weight of garbage. Using the information, the controller checks if the set threshold level is exceeded or not. The controller sends a message with the help of a GSM module to the Garbage collection local central office to notify that the garbage can is exceeded its capacity and disposal of waste is required. Accordingly, the authority sends the garbage can collecting vehicles to collect the garbage with the help of a robot mechanism. [1]

A system using an infrared sensor and a gas sensor was proposed by Pavithra. The IR sensor placed inside the trash sense the level of trash and the gas sensor will sense the toxic gases. Once the trash is filled, the alarm rings. The RFID placed inside the trash will

intimate about the overflowing of trash to the corporate office. The RFID placed at the corporate office is serially interfaced with the PC. Visual Basic is used to code the visual display. From the corporate office, the information regarding the removal of trash is sent to the respective area truck driver with the location of the trash can, and it will be displayed on LCD. If the bin is not replaced at a right time, the microcontroller placed in the trash can intimate the information to the corporate office once again. Until the trash is emptied, the intimation will be displayed in the LED at the corporation office. Once the truck driver removes the trash the intimation stops and continuous intimation to the corporation office and truck ends. Database of every trash bin can be maintained by the municipality. [2]

Parkash and Prabhu V. proposed a system that uses a combination of the integrated system combined with an RFID, IGPS, GPRS, GIS, and web camera which will solve the problem of waste. In this system, multiple bins are placed in the city, these dustbins are integrated with a device that tracks the level of the garbage in the bins. A unique ID is provided to all the bins so that we can identify which bin is full. When the garbage in the bin is full, the notification along with the unique ID is sent to the concerned authority with the help of the Internet and the bin can be emptied immediately. The paper gives us an overview of the municipal solid waste management (MSWM) system of the Municipality corporation. [3]

Nikita Nathrani et al. proposed a system consisting of a microcontroller, Wi-Fi module, GSM, DC Motor, Ultrasonic Sensors, and Telnet Protocols. It provides bidirectional communication for storing and retrieving data over the internet. In this, ultrasonic sensors are placed over the bins to detect the garbage level and inform the local authority about the status of the bins with the help of a message notification system. The level of bins can be remotely monitored via Telnet Protocol. The dustbin lid automatically shuts down once the garbage level reaches the threshold level until the bins are emptied by the cleaners. [4]

Twinkle Sinha, K. Mungesh Kumar and P. Saisharan proposed a system in which the garbage bin will contain a single directional cylinder which is used to compress the garbage inside the dustbin periodically thus preventing unnecessary occupying of the dustbin's space by light weighted but space-occupying garbage particles like sponges, etc. When the garbage reaches the threshold level, a leaf switched is pressed and an Arduino Uno is programmed in such a way that when the garbage reaches this level, intimation is given to the central hub in the form of glowing LED. After the garbage reaches this set threshold level, the lid of the dustbin will be closed until the garbage is not collected by the cleaners. [5]

S. S. Navghane, M. S. Killedar, and Dr. V. M. Rohokale proposed a system where bins are interfaced with a microcontroller having IR wireless systems as well as a central system showing the status of garbage, on the mobile web browser with an HTML page. This system assures the cleaning of bins as soon as the garbage level reaches its maximum level. If the dustbin is not cleaned in a particular duration, then the record is sent to a higher authority who can take appropriate action against the concerned authority. [6]

Ashwin, Mappilllai, Sashidharan and Premkumar proposed a system using sensors, ZigBee, Arduino and NodeMCU. The solar panel powers the system. Their model consists of multiple nodes interconnected with each other. Each node is connected to the firebase of the municipal corporation. The child node transmits data to the parent node. The waste level of the dustbins is collected with the help of ZigBee and the collected data and the location of that dustbin is then transmitted to an android app with the help of NodeMCU. [7]

Vinod, Senthil, Krishna and Mahantesh proposed a system in which garbage level is monitored using an Ultrasonic sensor. The weight of the garbage is monitored using a Force sensor. For both height and weight, a threshold level is set. This system also contains a LED that turns green when the bin is empty and red when the bin is full. There is a GSM system interfaced with the system. The microcontroller interfaces the sensors with the GSM. When the set threshold level is exceeded, the android application will display the alert message along with the exact location using latitude and longitude. [8]

SAF-Sutra is a system proposed by Shashank and Sanket that is divided into four layers that depend on the functionality. The first layer has sensors that capture the data required and transmits it to the second layer. In the second layer, the actuators will make decisions based on the programmed logic. The third layer consists of the cloud service which will store and analyze the data. The last layer is the android app used to access the data from the cloud. There are two subsystems — Waste Segregation and Garbage Monitoring [9]

III. PROPOSED SYSTEM AND METHODOLOGY

This particular system consists of a garbage bin connected with sensors and motors for proper waste management. The system has an IR sensor that detects the presence of the garbage on the plank of the dustbin and the moisture sensor detects if it is dry or wet waste. Depending on the type of waste is detected, the motor attached to the plank will rotate it to segregate it into dry and wet waste. The Ultrasonic sensor monitors a garbage bin continuously and when the amount of garbage reaches the threshold level, it instantly notifies the local authority with the help of a WiFi module and android app, which will help them to be informed about when the garbage should be collected. This manages the effort to check the area by visiting there. Hence, our proposed system will help in waste segregation as well as waste monitoring. This will effectively reduce the manpower, the cost, and the required resources. This system will be helpful for both the municipal corporation and the residents in the area.

This system can be divided into 4 phases-

Phase 1: It is the initial phase in which the bin is not used at all. At this point the bin is empty.

Phase 2: The user places the garbage onto the plank. The IR sensor senses the garbage and the moisture sensor detects if the garbage is dry or wet. Depending on the type of garbage, the motor driver will rotate the motor to segregate the waste.

Phase 3: This phase describes the monitoring part. The ultrasonic sensor will sense the garbage in the bin continuously. When the garbage reaches the threshold level, the LCD will display that the "Dustbin is full".

Phase 4: It is the final phase in which the local authority is informed about the level of the dustbin. The android app continuously updates the authority the level of the dustbin, i.e., low/medium/full.

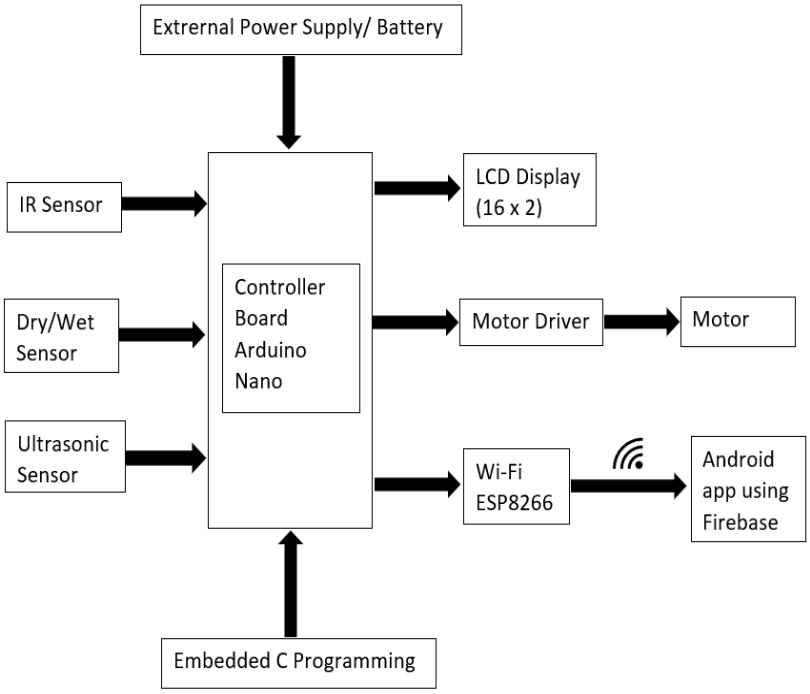

Fig. 1. Proposed System Architecture

Arduino Nano - Arduino Nano is a small microcontroller board. It is based on the ATmega328P. It has very similar connectivity and specs just like the Arduino Uno board. The software of the Arduino is well-suited to all kinds of operating systems like Linux, Windows, and Macintosh, etc.

Fig. 2. Arduino Nano Board

Infrared Sensor - It mainly has two sections IR Transmitter and Receiver, IR LED emits light, and in the range of Infrared frequency this acts as a transmitter on the other hand Photodiode acts as the IR receiver as its conducts when light falls on it. In this system, we will use it to check if the garbage is present or not.

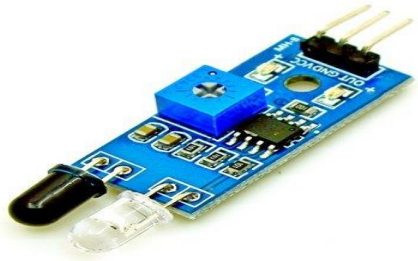

Fig. 3. IR Sensor

Moisture sensor - We use this to calculate the content of water available in the soil and also check the dryness wherever required. In this project, we will use it to check if the garbage thrown in it is dry waste or wet waste.

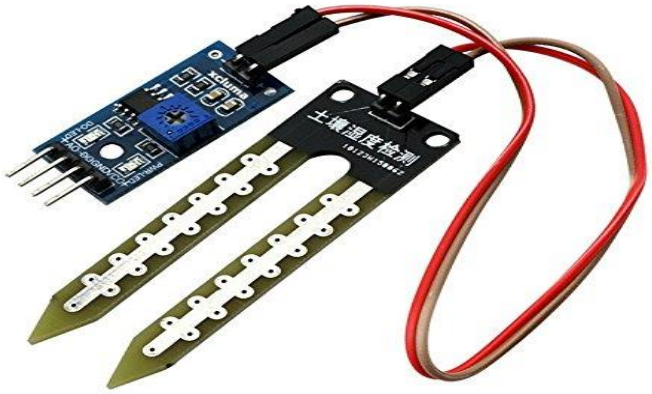

Fig. 4. Moisture/ Dry or Wet Sensor

HC-SR04 Ultrasonic Sensor - This sensor is used to transmit ultrasonic waves in the air, the nature of these waves is it gets reflected when an object acts as an obstacle in front of it while traveling. This sensor is used to monitor the level of the dustbin continuously.

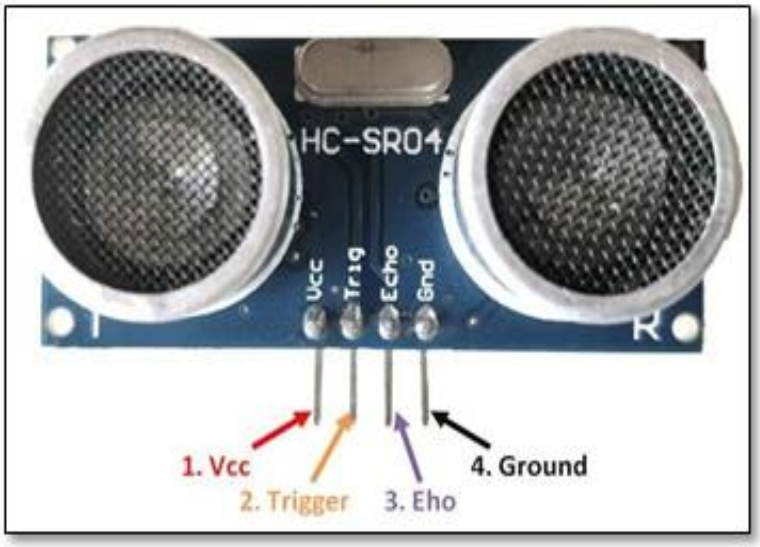

Fig. 5. Ultrasonic Sensor

2 x 16 LCD Screen - LCD can be interfaced with a microcontroller to read the output directly. In our project, we use a two-line LCD with 16 characters each. The LCD screen can display if the garbage bin is full or not and if the garbage is wet or dry.

Fig. 6. 2 X 16 LCD Screen

WiFi Module - The WiFi ESP8266 is a low-cost WiFi microchip with full TCP/IP and microcontroller capability, which helps connect the hardware to the software. With the help of this module, we can connect to the internet. We will use this to send the notification to the authority regarding the level of garbage present in the system.

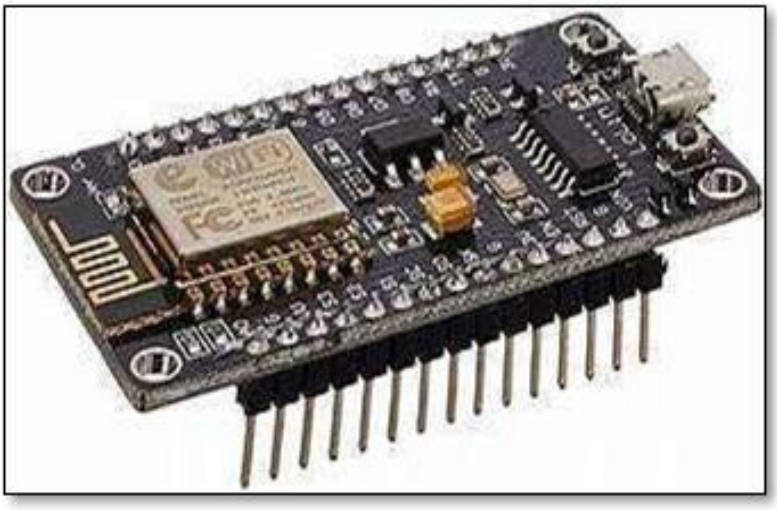

Fig. 7. Wi-Fi Module ESP8266

DC motor - This converts the direct current electrical energy into mechanical energy, this is a rotary electrical machine. This rotates the plank upon the dustbin in a clockwise or anticlockwise direction to segregate the waste into dry and wet.

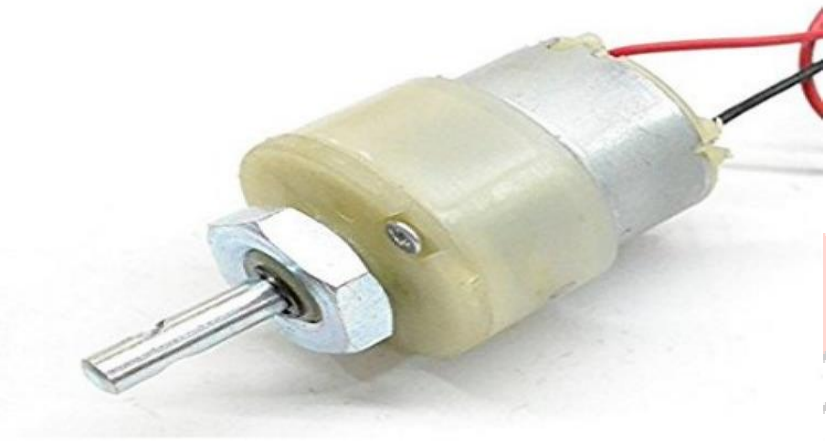

Fig. 8. DC Motor

Motor Driver - Implemented using H-bridge driver in IC-l293. It has high torque. This drives the motor in a specific direction for implementation.

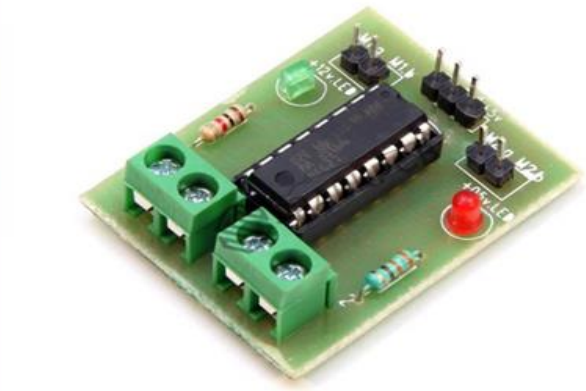

Fig. 9. L293D Motor Driver

IV. Results and Analysis

The two most important subsystems in this project are- segregation and monitoring. For the segregation part, we have mainly used two sensors – an object sensor and a dry wet sensor. The IR sensor will detect the garbage on the plank and the dry wet sensor will detect if the garbage is wet or dry waste to segregate the garbage.

Fig. 10. Detection of wet waste

Figure 10 describes the segregation of wet waste. When the dry wet sensor identifies the garbage as wet waste, the plank rotates in the anticlockwise direction and the waste falls on the left side of the dustbin.

Fig. 11. Detection of dry waste

Figure 11 describes the segregation of dry waste. When the dry wet sensor identifies the garbage as dry waste, the plank rotates in the clockwise direction and the waste falls on the right side of the dustbin.

For the monitoring part, the Ultrasonic sensor is mainly used. The ultrasonic sonic sensor will continuously detect the height of the garbage in the bin. As the garbage reaches the threshold level, the LCD displays that the dustbin is full. Along with the LCD, the notification is sent to the local authority through an android app.

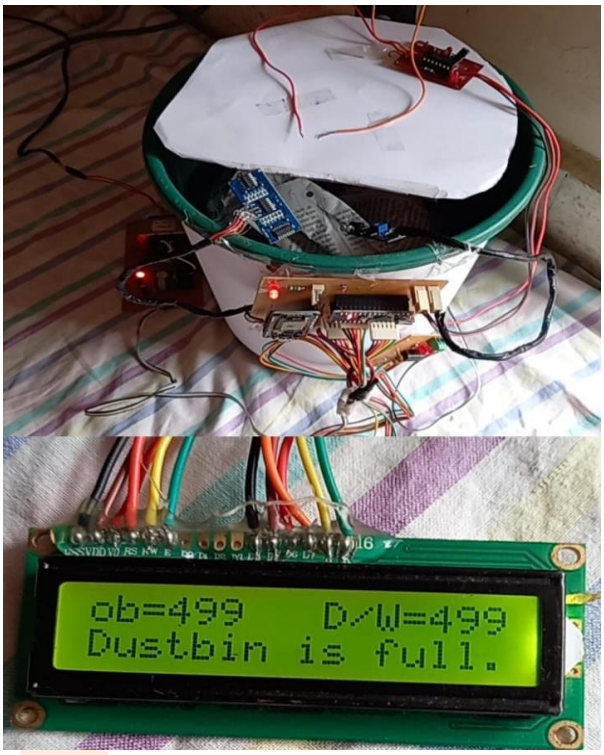

Fig. 12. Waste Monitoring

The android app is made using Google Firebase.

Fig. 13. Android app Login Page GUI

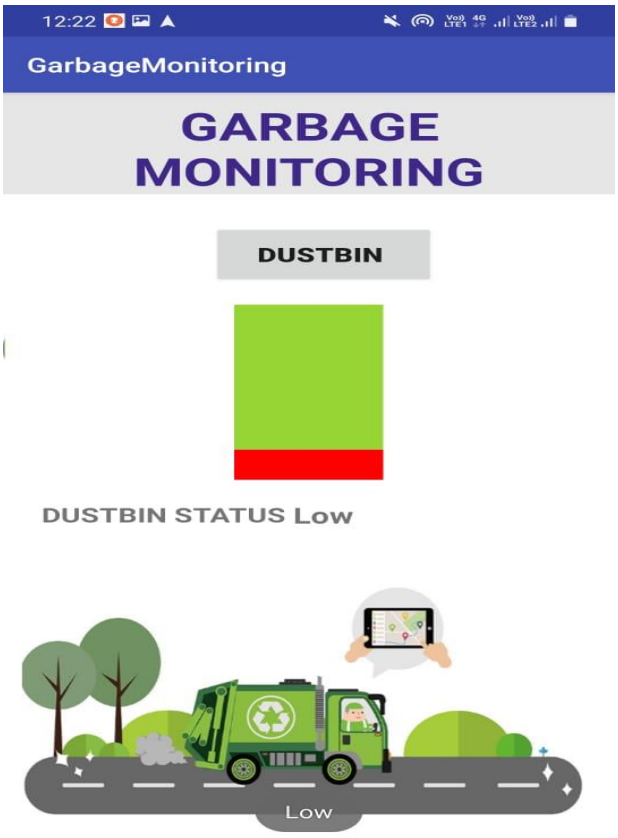

Fig. 14. Dustbin status updated: Low

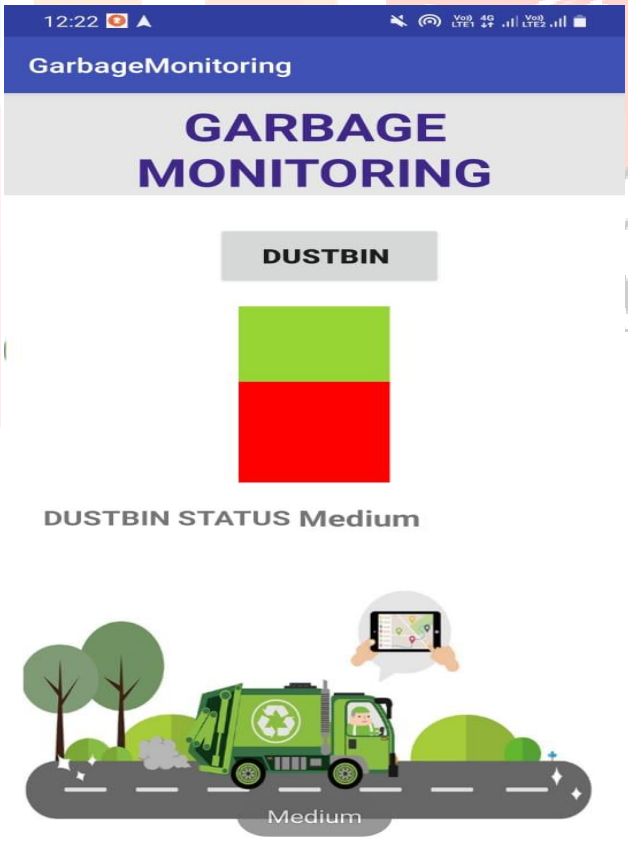

Fig. 15. Dustbin status updated: Medium

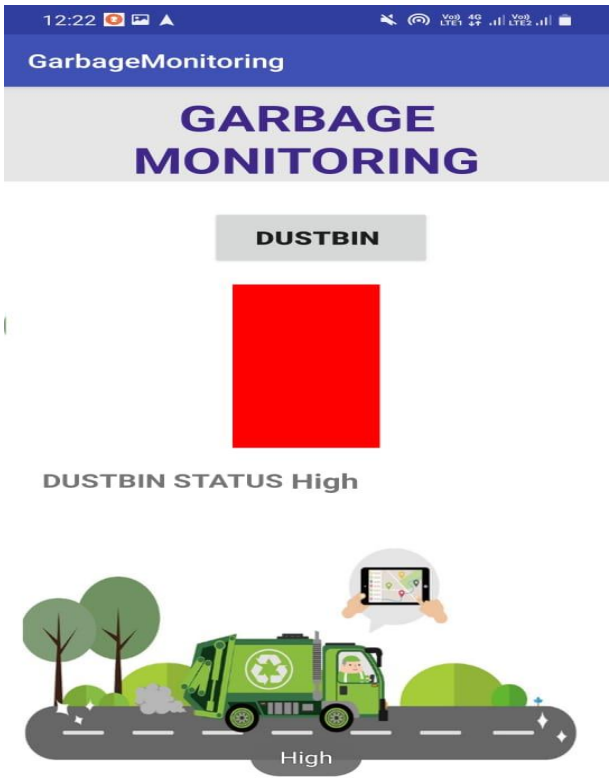

Fig. 16. Dustbin status updated: High

The android app notifies the authority of the status of the dustbin so that they can collect the dustbin before it overflows, thus preventing littering.

V. Conclusion and Future Scope

The lethargic lifestyle of humans concerning waste management gave us an idea to implement this Smart Garbage System. This system can be used at public places, government offices, malls, educational institutes, community bins and so many other places. This system will help us in making our surroundings cleaner and it would be a boon for the cleaners whose job is to collect the garbage from designated places and segregate it into wet and dry waste.

Our project is only a prototype, i.e., this project is made for a single dustbin. We can further integrate the bins, each dustbin with a unique ID and the local authority can be notified which bin is full, using that unique ID. Further, a GPS module can be integrated with each dustbin which sends the status and the location of the bin. Lastly, the whole system can be made water-resistant.

References

[1] Gaikwad Prajakta, Jadhav Kalyani, Machale Snehal, “Smart Garbage Collection System in Residential Area” International Journal of Research in Engineering and Technology, vol. 04, no. 03, pp. 122–124, Mar. 2015.

[2] Pavithra, “Smart Trash system: An Application using ZigBee” International Journal of Innovative Science, Engineering & Technology (IJISET), Vol. 1 Issue 8, October 2014, pp. 319-323

[3] Parkash, Prabu V, " IoT Based Waste Management for Smart City," International Journal of Innovative Research in Computer and Communication Engineering (IJIRCCE), Vol. 4 Issue 2 February 2016, pp. 1267-1274.

[4] S.S.Navghane, M.S.Killedar, Dr.V.M.Rohokale, “IoT Based Smart Garbage and Waste Collection Bin”, International Journal of Advanced Research in Electronics and Communication Engineering (IJARECE) Volume 5, Issue 5, May 2016, pp. 1576-1578.

[5] Twinkle Sinha, K.Mugesh Kumar, P.Saisharan, “Smart Dustbin”, International Journal of Industrial Electronics and Electrical Engineering (IJIEEE), Volume-3, Issue-5, May 2015, pp. 101-104.

[6] Nikita Nathrani, Monika Belani, Akansha Agrawal, Shivani Pathak, Yash Tawarawala, Sanket Kasturiwala, “Waste Monitoring System using Internet of Things ”, International Research Journal of Engineering and Technology (IRJET), Volume: 05 Issue: 04, Apr-2018, pp. 2931-2935.

[7] Aswin Raaju, V., Mappilllai Meeran, J., Sasidharan, M. and Premkumar, M. K. (2019). “IoT Based Smart Garbage Monitoring System Using ZigBee”. 2019 IEEE International Conference on System, Computation, Automation and Networking (ICSCAN). doi: 10.1109/icscan.2019.8878742

[8] Kumar, S. V., Kumaran, T. S., Kumar, A. K., & Mathapati, M. (2017). “Smart garbage monitoring and clearance system using internet of things”. 2017 IEEE International Conference on Smart Technologies and Management for Computing, Communication, Controls, Energy and Materials (ICSTM). doi:10.1109/icstm.2017.8089148

[9] Shetty, S., & Salvi, S. (2020). SAF-Sutra: A Prototype of Remote Smart Waste Segregation and Garbage Level Monitoring System. 2020 International Conference on Communication and Signal Processing (ICCSP). doi:10.1109/iccsp48568.2020.9182408