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Smart Waste Management System using IoT

Bindushree V[1], Manasa M[2], Sanjana Rao[3], Vidyashree T S[4], Gowra PS [5]

[1-4]Student, Dept. of Electronics Telecommunication Engineering, BMS College of Engineering, Karnataka, India
[5]Associate Professor, Dept. Electronics of Telecommunication Engineering, BMS College of Engineering, Karnataka, India

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Abstract - *An The aim of the project is to implement an efficient method to manage the waste in big cities as well as small ones. The issue of disorganized garbage collection is the biggest hurdle in our everyday life to reduce it, an IoT system is developed that will keep track of each bin depending upon the level filled. This is through an electronic system which segregates wet and dry waste. A setup consists of several sensors which includes IR sensor for detecting the presence of any waste and soil moisture sensor to detect whether the waste is dry or wet. Here, whenever the IR sensor detects any waste, the motor will turn towards either dry bin or wet bin depending on the soil moisture sensor's value. Ultrasonic sensors are placed at the top of each bin and is used for calculating duration by sending a signal. The signal is thus used to calculate the amount of space available in the bin, thereby helps to clear the bin as and when the bin is near to full. The graph of bin level is obtained in ThingSpeak. Whereas IFTTT platform is used to receive the mails on the registered mail ID of the authority monitoring the dust collection. Both ThingSpeak and IFTTT are IoT platforms which helps to monitor the bins so that regular monitoring of the bins can be avoided.*

Key Words: Automated system, IoT, IR Sensor, Ultrasonic Sensor, Waste segregation.

1.INTRODUCTION

This As the population of the world is increasing exponentially, waste production is also increasing. In India waste generated every year is about 60 million ton. Approximately 0.6 kilograms of Garbage per head per day. In overcrowded cities, ten million ton of trash are generated. The garbage lot of majorities of the cities are flooding with no space for new waste. Moreover, maximum of waste collected is in mixed form. At present, waste is getting segregated manually and the efficiency of waste segregation is very less i.e., there is a maximum possibility of dry waste and wet waste getting mixed. Improper waste disposal can cause degradation of the atmosphere. Therefore, a waste management system which separates dry waste with wet waste is necessary. Indian government have launched an event called "Swachh Bharat Abhiyan" in 2016 and its purpose is to make India a clean country. As we know that waste which we dump to dumpsters need to be cleaned periodically, there is a need for employees to separate waste and this causes hazards to employee's health. As the population density increases in certain place waste produced by that place will be more and the periodical cleaning of dumpsters will become inefficient since population varies greatly from area to area.

Fig -1: Manual Waste Segregation

Internet of things (IoT) technology is progressing rapidly in various domains such as medical science, automotive industries and smart cities.[1].

In this project dry waste and wet waste can be separated efficiently and the levels of dumpsters/dustbins, can be detected with the help of IOT associated software called ThingSpeak and IFTTT platform. The graph in ThingSpeak shows the level of dustbins and the person in front of the monitoring system can get access to it by using Wi-Fi. The graph shown in ThingSpeak represents the amount of space remaining in the bin to accommodate further waste and whenever the bin is full graph shows minimal value.

IFTTT is a platform, abbreviation - If This Then That. The Webhooks platform from IFTTT is used which helps in sending mails if the bin is full. Whenever any of the bin is full Webhooks sends a mail to the registered mail ID saying Wet bin is full or Dry bin is full based on which among the two bins is filled.[2].

This is one of the efficient methods to separate dry and wet wastes and once the bin is full the monitoring authority will get the mail to clear the dumpster or by viewing the graph, bins can be cleaned regularly. Therefore, most of the issues such as health hazards and atmospheric imbalance can be avoided.

2. RELATED WORKS

V. Soundharya et al proposed Smart Waste Segregation and Monitoring System using IoT. In this paper, 3 types of waste namely dry, wet and metallic wastes' segregation is described. This takes place with the help of sensors. [2]. Swati Sharma et al have proposed a "Smart dustbin management system" Here, dustbins are equipped with low-cost smart devices and they have been placed in all four directions. Those devices can be monitored by the employee and admin of the system so that undesirable flow of garbage is avoided. [3]. Shyamala S.C et al have proposed a "Smart Waste Management System". In this paper, traditional waste management system was upgraded by inserting smart sensors to gather the data and the condition of garbage present in the bins. Server receives this data and processes it is being discussed.[4]. Bhupendra Fataniya et el proposed a work on "Implementation of IoT based Waste segregation and Collection system"They have considered three basic entities such as sensing nodes, cloud and mobile application. The sensing nodes includes ultrasonic sensor, moisture sensor and gas sensor. Ultrasonic sensor provides the value of the distance available in the bin.[6]. Sivasankari et al proposed "Smart Waste Management Using WSN and IoT". In this method Waste is collected as usual. Sensors are deployed on the bins which are networked together using Wireless Sensor Network (WSN) to collect waste from the bins [7]. Prof. S.A. Mahajan et al have proposed "Smart Waste Management" In this paper, public garbage bins are attached to a device which monitors the level of garbage in the bins is discussed. [8]. Teoh Ji S et al proposed An Internet of Things Based Smart Waste Management System Using LoRa and Tensor-flow Deep Learning Model. Here, LoRa to send the sensor data and Tensor-flow for object classification are used for waste segregation along with Raspberry Pi [9]. G U Fayomi et al in Smart Waste Management for Smart City: Impact on Industrialization propose the use of artificial intelligence (AI) to solve waste management such as convolutional neural network for efficient classification and waste identification and other AI technology presenting a review of the technologies involved in implementing smart management. In order to satisfy the area of environmental safety, an in-depth study of each element is taken into account.[10]. Dattatray Waghole et al in Smart Bin for Waste Segregation and Energy Generation using IoT propose a smart bin that can notify the municipality at various phases of waste disposal. When it exceeds 30%-60%, it generates an alarm to the garbage collector assigned to the region. When the proportion reaches 90%, a warning will be issued to the necessary officials.[11].

3. REQUIREMENTS

A. Hardware

- DC gear motor

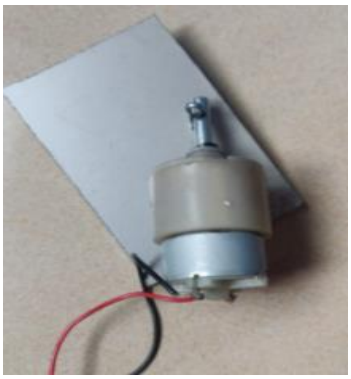

Fig -2: DC Gear Motor

DC gear motor is shown in Figure 2. It obtains the supply voltage from battery and converts it into a mechanical energy by rotating the rotor and the direction of rotation is coded using Arduino IDE with the help of motor driver board.[2]

- IR sensor

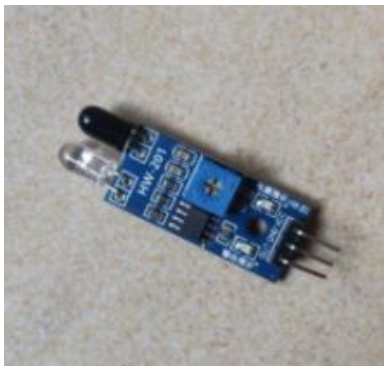

Fig -3:IR Sensor

IR sensor is shown in Figure 3. It has been used to detect the presence of waste thereby DC motor rotates either in direction of wet waste bin or dry waste bin.[3]

- Motor driver board

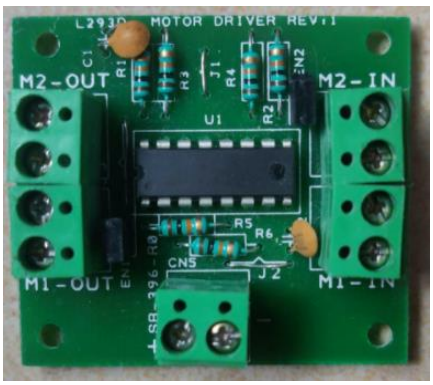

Fig -4: Motor Driver Board

Motor driver board is shown in Figure 3. It helps in rotating the motor in the desired direction i.e., either in clockwise or in anticlockwise direction.

- Node MCU ESP8266

Fig -5: Node MCU ESP8266

Node MCU ESP8266 is shown in figure 5. This is used for integrating all the other electronic components that are used to build the prototype and the coding is done using Arduino IDE [5].

- Soil moisture sensor

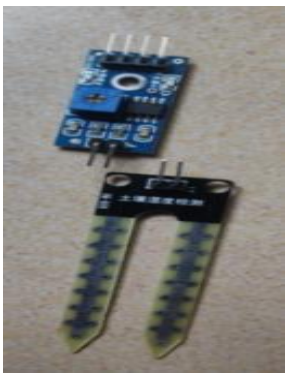

Fig -6: Soil Moisture Sensor

Figure 6 shows the Soil moisture sensor used in the prototype. It is used to check the water content from the waste placed on it and helps the waste to fall in right bin.[4].

- Ultrasonic sensor

Fig -7: Ultrasonic Sensor

Figure 7 shows the Ultrasonic sensor used in the prototype. This HC-SR04 sensor is used for measuring distance. It uses sound waves to calculate the same. There are 4 pins – Echo, Ground, Trigger and VCC. External controller is triggered by Trigger pin that sends ultrasonic waves whereas echo pin sends ultrasonic waves and duration it takes to travel decides the distance available in the bin. VCC will take up to 5V and gives the voltage so that the sensor can run.[5].

B. Software

- Arduino IDE

Fig -8: Arduino Uno

Figure 8 shows the software used in this project, Arduino IDE. This is an application written in C and C++. Programs can be written and uploaded to Arduino boards. The version used in here is 1.8.9.

- IFTTT

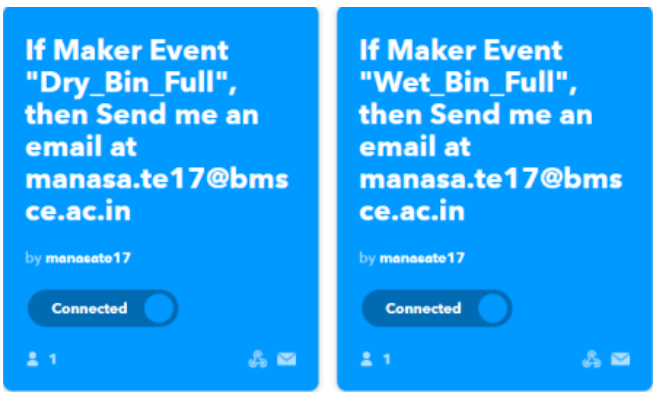

Fig -9: IFTTT

Fig 9 shows IFTTT which stands for "If this, then that." It is an IOT platform that helps to send the mail to the person who is managing the bins. Therefore, it avoids the overflow of waste from the bins as it sends a notification to the concerned authorities.[6].

- ThingSpeak

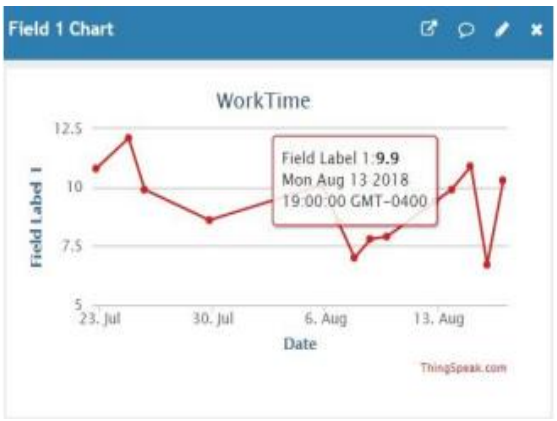

Fig -10: ThingSpeak

Figure 10 shows the ThingSpeak application. This shows the available space in bin with respect to dates. It will obtain the data from ultrasonic sensor and thereby plots the available space in both the bins in a graphical format.

4. IMPLEMENTATION

ESP8266 Node MCU is used as an interface for all the components. Code has been executed in Arduino IDE platform.

Whenever the waste is detected, IR sensor connected to pin D3 of Node MCU gets activated. Additionally, Analog pin A0 of soil moisture sensor connected to A0 of Node MCU detects the level of moisture in the waste. After detecting the same, DC motor starts rotating to dump the waste to its respective bins. To rotate DC Motor L293D IC is used where In1 and In2 of L293D is connected to D1 and D2 of Node MCU.Out1 and Out2 is connected to 2 Pins of Motor. Motor will rotate towards clock wise for wet bin and anti-clock wise for dry bin

After waste is dumped into bins, ultrasonic sensor detects the distance covered by those bins to notify whether the bin is full. This is done by calculating the duration with the help of echo pin of ultrasonic sensor. The formula to calculate distance is given by

Distance = Duration*0.034/2

After the waste is dumped into bins the Distance will be displayed in ThingSpeak platform. If the bin is full, Graph in ThingSpeak reaches 3 according to our code so that the user can clean the bin by viewing the graph. If it is not full it will display the available distance.

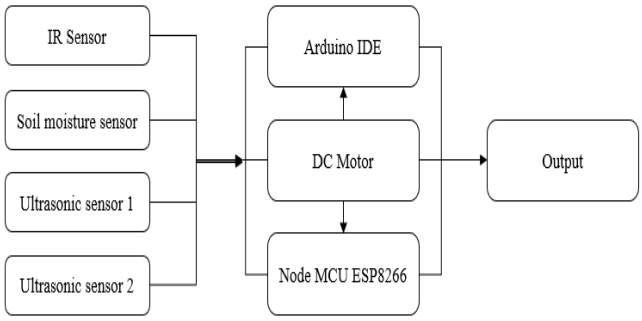

Fig -11: Block diagram

Webhooks from IFTTT platform is used to send a mail to the monitoring authority only if the bin is full. It will send a notification as "Wet bin is full" if wet bin is full, if dry bin is full webhooks sends a notification as "Dry bin is full". Once the level in the bin is decreased, whenever the bin is full again mail will be received by the maintaining authority.

The Flow chart is as shown.

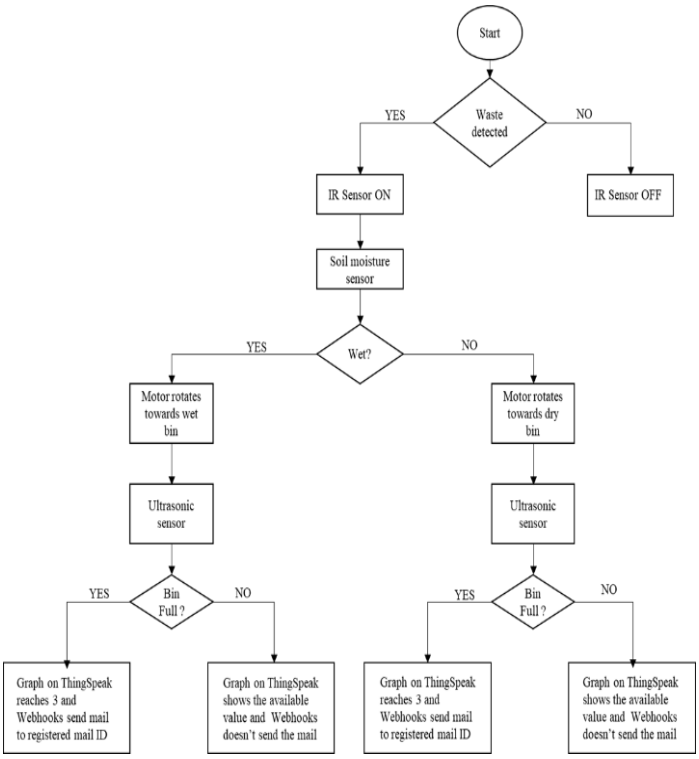

Fig -12: Flowchart

Table -1: Comparison between manual and automatic system

Features	Manual	Automatic (Designed Prototype)
Health issues	Yes	No
Effectiveness	No	Yes
Environment friendly	No	Yes

5. RESULTS

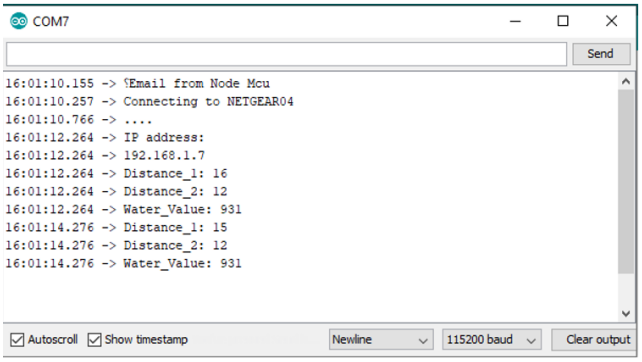

Fig -13: NodeMCU connecting with webhooks

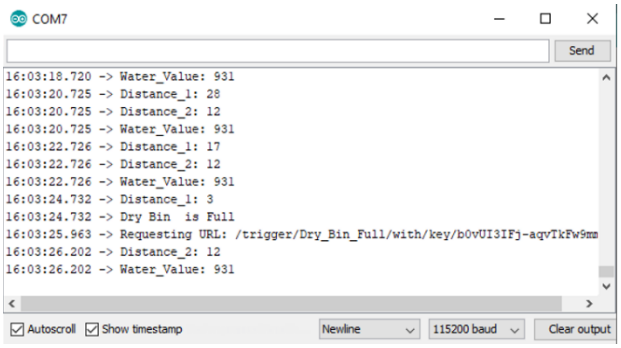

Fig -14: Requesting URL

In the above image the Webhooks is requesting the URL to send the mail to registered mail ID.

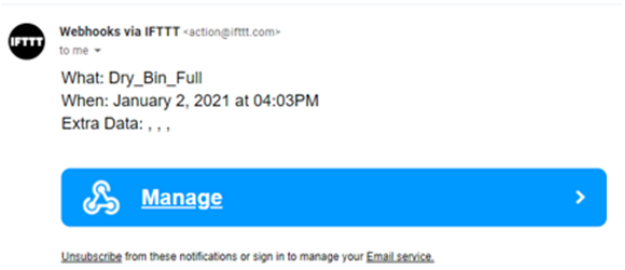

Fig -15: Mail representing dry bin is full

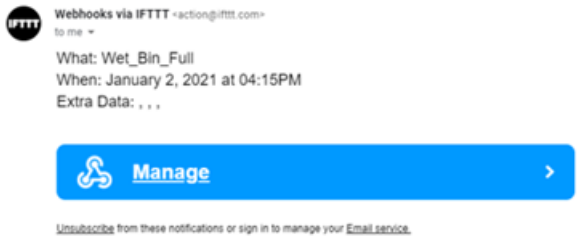

Fig -16: Mail representing wet bin is full

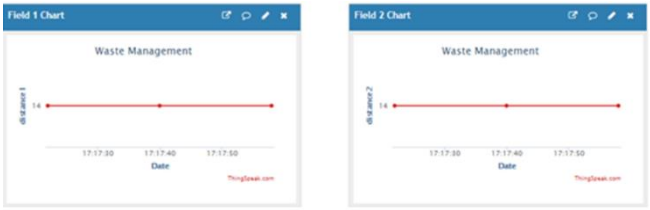

Fig -17: Graph in ThingSpeak when both the bins are empty

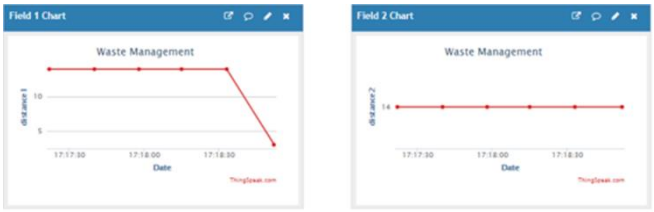

Fig -18: Graph in ThingSpeak when one bin is Empty and the other bin is full

Fig -19: Graph on ThingSpeak representing equal amount of waste

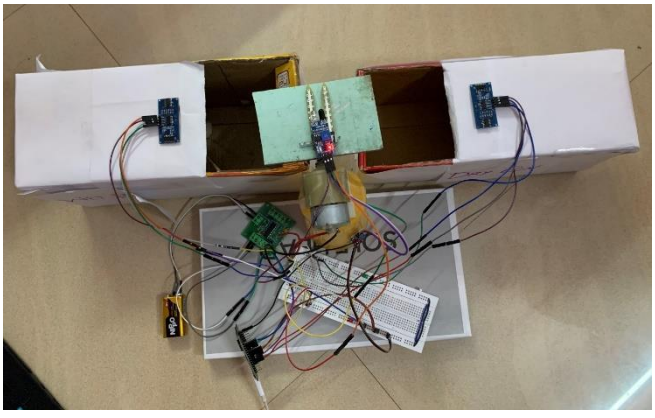

Fig -20: Prototype of our project

Fig -21: Motor turning towards dry bin

In this image an eraser is placed which is a dry waste.

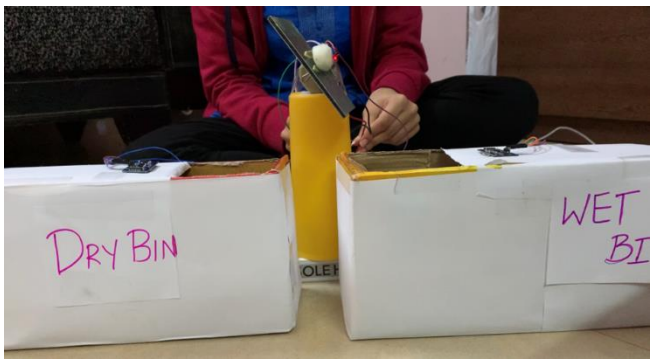

Fig -22: Motor turning towards wet bin

In this image a wet tissue paper is placed which is a wet waste

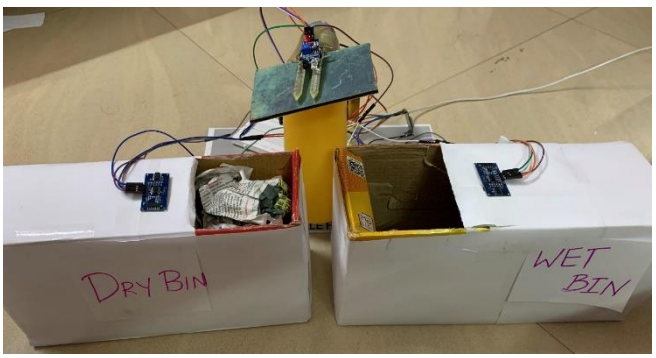

Fig -23: Dry bin is full

6. CONCLUSION AND FUTURE SCOPE

In our project we have implemented an IOT based smart waste segregation system. ThingSpeak and Webhooks from IFTTT are used to obtain the status of the bins and soil moisture sensor to segregate dry and wet waste. This project helps to separate Dry and wet waste without human intervention thereby reducing the hazards to human health as well as to environment. However, this can only be implemented in small scale. Whereas when

used in big metropolitan cities a higher-level system which takes waste by itself and segregates waste is needed.

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