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A Prototype of the Waste Segregation and Remote Garbage Level Monitoring System

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Abstract: ***The proper management of waste is a significant challenge faced by urban areas worldwide. The lack of an efficient and effective waste management system results in environmental degradation and health hazards. This paper proposes a solution to the problem of waste management by designing and implementing a remote smart waste segregation and garbage level monitoring system. The system consists of two subsystems: waste segregation and garbage level monitoring. The waste segregation subsystem uses sensors to detect the type of waste and segregate it into different dustbins based on its properties, while the garbage level monitoring subsystem uses ultrasonic sensors to monitor the garbage level and send data to cloud for remote monitoring and analysis. When the level of garbage reaches a specific threshold, the system sends an SMS to a pre-declared phone number.***

Keywords: Waste segregation, Garbage level monitoring, Remote monitoring.

I. INTRODUCTION

Waste management is a major issue faced by many countries around the world, as the amount of waste produced is increasing day by day. Several techniques have been proposed to
tackle this issue, including waste segregation and monitoring systems. One such system is the Remote Smart Waste Segregation and Garbage Level Monitoring System which is proposed [1].
The system consists of two subsystems: Waste Segregation and Garbage Level Monitoring. The Waste Segregation Subsystem uses sensors such as inductive proximity
sensor, and moisture sensor to segregate the waste into metallic, dry, and wet waste respectively [13]. With the help of an ultrasonic sensor the garbage level in each bin is monitored and then the garbage level value is sent to the cloud for remote monitoring and analysis in Garbage level monitoring Subsystem [11].
Several previous studies have proposed waste segregation and monitoring systems. For instance, a green bin model was proposed [2] in order to differentiate everyday waste into wet and dry waste. However, the existing system is complex. Another study proposes a segregation prototype in [3] which it uses dielectric constant values to segregate waste into dry, wet. However, this method fails to classify the waste into metallic waste. A recycling bot was suggested that can distinguish recyclable materials from non-recyclable ones using image processing technologies. However, due to the complexity of this system, effective operation between modules is required.
In contrast, this proposed system is compact, efficient, and uses simple techniques for waste segregation and monitoring. The system can also be integrated with an Android application for remote monitoring and analysis.

II. LITERATURE SURVEY

Several waste segregation models have been proposed to improve the recycling process. A green bin model was established, in which waste is divided into dry and wet waste using five distinct bins [1]. However, this system is complicated. Based on the values of the waste material's dielectric constant, a model that divides trash into wet and dry waste was created. [2]. However, this method fails to classify the waste into metallic waste.
Another model, uses sound resonance to segregate plastic bottles and tin cans was developed [4]. A platform made of galvanized iron was designed. However, this technology does not offer a complete trash segregation solution; it merely separates the garbage into tin cans and plastic bottles [13].
With the aid of ZigBee technology, a recycle bot was created to separate waste into recyclable and non-recyclable materials. However, due to the complexity of this system, communication between modules is necessary for effective operation [6].

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A solution was put forth employing an IoT-based system for the collection and disposal of household garbage [7]. The system strives to maintain communities clean, but it does not concentrate on strategies for residential trash segregation and recycling [12].
The classification of garbage into biodegradable and non-biodegradable categories was done using a waste management system powered by deep learning algorithms. [8]. Nonetheless, to attain optimal outcomes, the system requires thorough training. Failure to do so could lead to a significant decline in its efficiency.

Table 1: Comparison of existing System with Proposed System

Parameters	Existing Model	Methodology
Components	Microcontroller, Sound frequency, Image Processing, Android App IOT, AI	Arduino UNO ThingSpeak is used for continuous monitoring of dust bins.
Segments	Recyclable and non-recyclable. Plastic bottles, tin cans. Plastic/Paper, Biowaste, glass. Dry, wet, metal Bio degradable and Non-bio degradable. No segregation.	a) Wet waste b) Metallic waste c) Dry waste
Sensors	Capacitive,inductance, Moisture, IR sensor	Inductive proximity sensor, moisture sensor and ultrasonic sensor
Compatibility	The above methods occupy large space and it is complex in nature.	Easy to install and operate.

The existing and suggested approaches are vividly evaluated in the table above.

III. METHODOLOGY

The proposed system uses the methodology of remote smart waste segregation and garbage level monitoring system that is designed to solve the problem of inefficient waste management and garbage overflow in public places. The system consists of two subsystems: waste segregation sub-system and garbage level monitoring sub-system.
The waste management system comprises of several subsystems, the first one being waste segregation sub-system, in which waste is divided as metallic, wet, and dry waste with the aid of sensors which help in identifying various categories of waste and sort them accordingly, and the waste being placed on a moving conveyor belt.
An inductive proximity sensor is used to identify metallic waste. If inductive proximity sensor detects the waste as metallic waste, then the dustbins that are mounted on the servo motor rotate 90^{o} and the waste falls into metal waste bin. If the waste is not metallic, it will move forward and be detected by the moisture sensor. If moisture sensor detects the waste as wet waste, then the dustbins mounted on the servo motor will spin 180^{o} and then the waste will fall in the wet bin. If the garbage is dry, it will proceed forward and finally land in the bin designated for dry waste at 0^{o}. This subsystem ensures efficient segregation of waste, reducing the need for manual segregation, and improving the recycling process.

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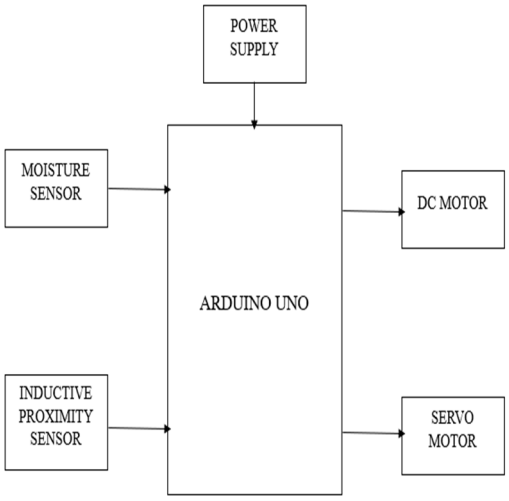


Figure 1: Waste Segregation Sub-system

The second subsystem is the garbage level monitoring system. This system is designed to monitor the amount of garbage in the bins and send alert notifications to the remote device when the bin reaches a certain threshold level. The sub-system employs an ultrasonic sensor which measures the distance from the sensor to the waste inside the bin.

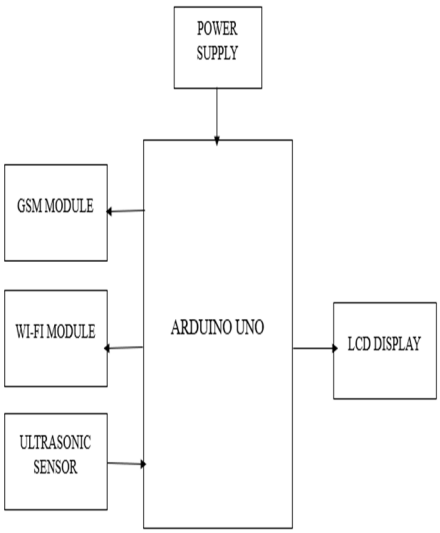


Figure 2: Garbage level monitoring sub-system

The sensor sends a signal to the microcontroller board, which processes the data and displays the level of garbage on an LCD display and the system also notifies to a predefined phone number through SMS that the bin is full, if the amount of waste inside the bin reaches a certain threshold value (in this case, 15 cm). ESP8266 Wi-Fi module is used in the system in order to transmit the data to ThingSpeak cloud server using an API key. The server then stores the data and can be accessed remotely for monitoring and analysis purposes [9].

To ensure smooth functioning of the system, a mobile application is designed to remotely monitor the garbage level. The mobile application provides access to the data collected over the cloud. The proposed system also ensures efficient use of resources by avoiding unnecessary manual segregation and ensuring timely garbage collection [10].

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A prototype of the waste segregation and remote garbage level monitoring system is shown below.



Figure 3: Overview of the prototype of waste segregation and remote garbage level monitoring system

IV. RESULTS

When the level of garbage reaches a specified threshold value, the system sends an SMS to a pre-declared phone number. The GSM results of the proposed system is shown in the figure below.

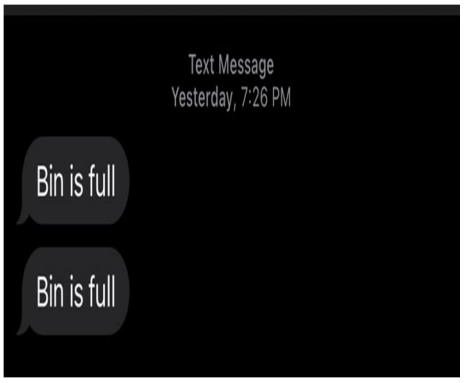


Figure 4: GSM Results

The garbage level of the bins detected by ultrasonic sensor are continuous shown on the LCD Display Screen as shown in the figure below shows



Figure 5: LCD Display of garbage level monitoring

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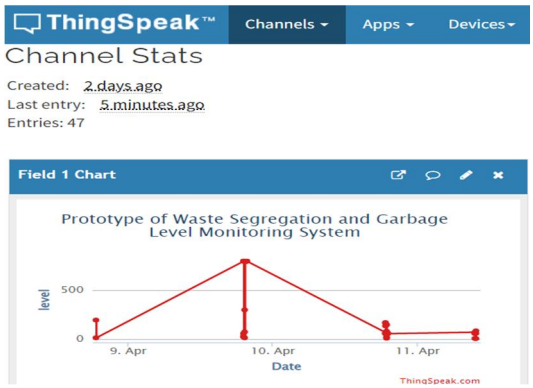


Figure 6: ThingSpeak output of Garbage Level Monitoring System

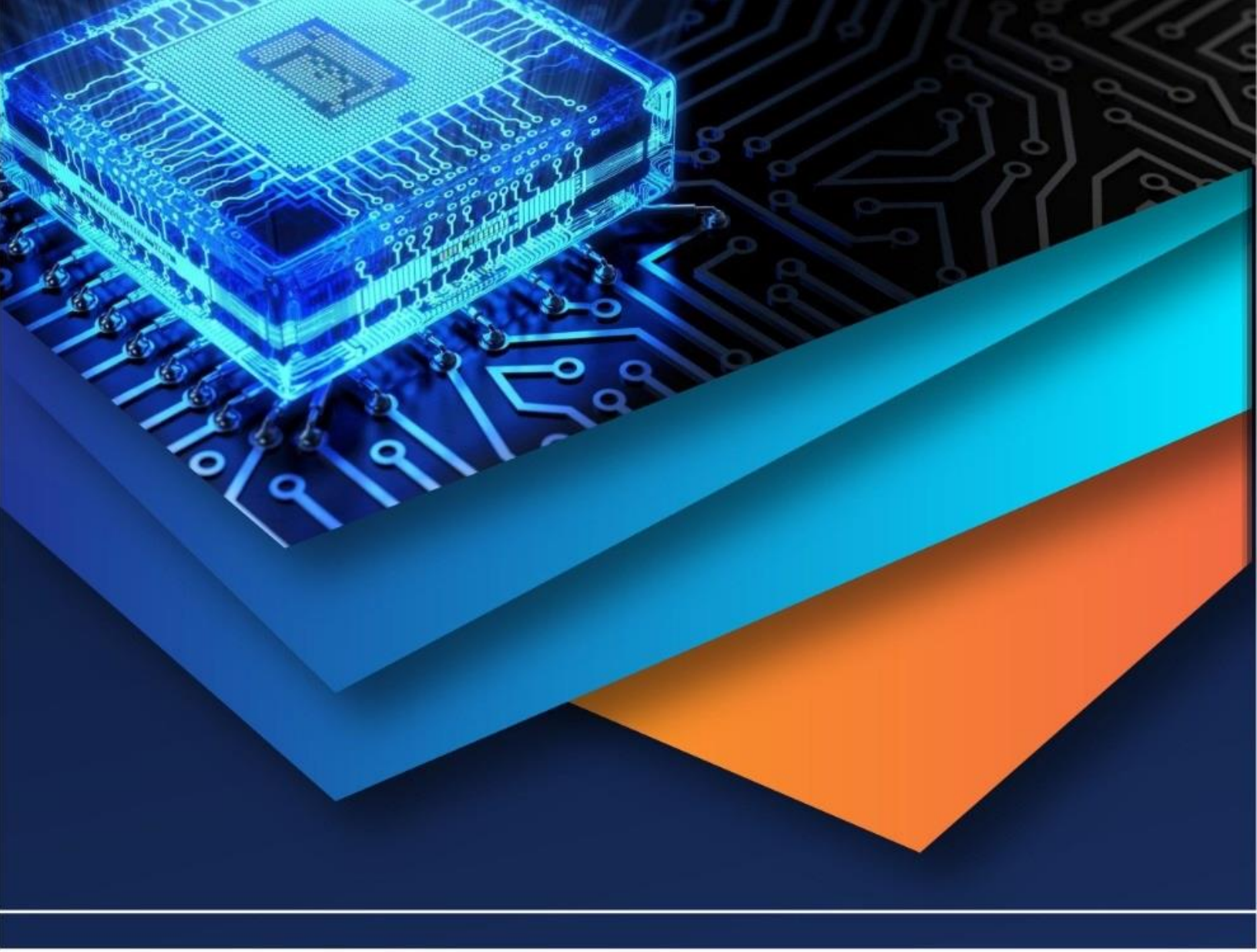
The above graph i.e., figure 6 shows the ThingSpeak results of the proposed system of Waste Segregation and garbage level monitoring System. The x-axis of the graph represents the bin level in cm and y axis represents the date. On 11th April the bin level is shown as 68.54cm at 9.36 am and later the bin level is shown as 35cm at 11.45am. The ThingSpeak application is an IoT application that constantly updates the bin level over the cloud. In this way we can monitor the bin level remotely and analyses the data of bin level daily, weekly and on yearly basis.

V. CONCLUSION

The proposed remote smart waste segregation and garbage level monitoring system is a step towards efficient waste management and recycling. The system ensures efficient segregation of waste and timely garbage collection. With the use of advanced technologies such as sensors and Wi-Fi connectivity, the system ensures smooth functioning and remote monitoring of the garbage level. The system can be implemented in public places such as parks, bus stands, railway stations, and other crowded areas, ensuring a cleaner and healthier environment.

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