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“ Smart Waste Management Using Coupon System ”

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***Abstract*— This study examines the development of a smart waste management system that encourages effective waste disposal and recycling by rewarding responsible behavior. Through a coupon incentive model, the system offers community members redeemable digital or physical coupons for responsible waste management, which can be used at local businesses. By tracking user participation through a mobile app, the initiative aims to build a sustainable culture, boost recycling rates, and raise awareness about waste issues. The paper highlights potential benefits, such as economic gains for local businesses and positive environmental impacts, while also discussing challenges like technology access and maintaining user involvement. This innovative approach seeks to create a collaborative framework for waste management, motivating residents to take an active role in environmental care.**

Keywords— Smart waste management , Coupon incentive , Recycling, Waste disposal , Community engagement , Sustainability , Mobile application , Environmental awareness , Local businesses , Incentive program, Waste reduction , Digital coupons ,Eco-friendly practices

I. INTRODUCTION

The Smart Waste Management using a Coupon System project intends to solve the waste disposal issues in metropolitan cities by rewarding people for dumping their trash appropriately using a coupon system. Overfull waste baskets, unscheduled waste collection, and littering in public areas cause environmental degradation and health threats in most developing nations. This project solves these problems by pairing IoT technology with a novel reward mechanism: whenever a user throws away waste into a smart bin, they are rewarded with redeemable coupons.

The system is equipped with sensors to identify when waste is dropped and monitors the level of fill in the bin, allowing collection only when it is required. With this method, we intend to streamline waste collection routes, lower operating expenses, and make citizens responsible for waste disposal. Besides, this coupon system not only creates a cleaner world but also increases public participation, making waste management a community-based program.

1.1 Motivation

The inspiration for the Smart Waste Management using a Coupon System project is driven by the desire to design cleaner, healthier cities through reducing public littering and waste overflows. Overfilled bins and ineffective waste collection systems in most cities cause pollution, stench, and health hazards that affect residents as well as the environment. Conventional waste management systems tend to lack the incentives needed to engage the community in keeping public areas clean.

By incorporating a coupon-based reward system, this project hopes to incentivize people to participate actively in correct waste disposal.

Offering redeemable rewards teaches users to utilize designated bins, which makes them responsible and proud of keeping their environment clean. This not only minimizes waste in public areas but also makes waste collection more efficient with notifications for authorities once bins are filled, hence encouraging optimal utilization of resources. Finally, the project seeks to establish a sustainable waste management system that would contribute to the welfare of the community and the environment.

1.2 Problem Statement

Due to the accelerated urbanization and rising population, proper waste management has emerged as an important issue for cities globally. Conventional systems of waste collection are ineffective, tending to result in filled bins, insanitary environments, and additional expenses due to unpredictable

collection timetables. Citizens are not inspired to manage their waste responsibly, adding to the problem.

1.3 Proposed Solution

To counter the inefficiencies of traditional waste management, a technologically savvy smart bin with a coupon-based reward system is a sustainable and cutting-edge solution. The smart bins are fitted with IoT sensors, such as ultrasonic sensors to detect fill levels and moisture sensors to differentiate between wet and dry waste, making it possible to track in real-time and automating segregation. The information is processed with a microcontroller (such as Arduino Uno), also controlling bin notification and user interaction. Upon proper waste disposal by users, a QR code is produced and shown on a display. Readership of the code via a mobile app associates the user with a virtual reward system, where they receive coupons or discounts as rewards for their engagement. This gamified model instigates citizens to become involved in proper waste disposal, leading to a cleaner city life and minimizing the operational expenses and inefficiencies linked with the conventional collection methods. The use of smart technology coupled with behavioral rewards ensures responsibility and stimulates green behavior among the populations in cities.

1.4 Objectives

- Encourage waste segregation by rewarding users with coupons.
- Increase recycling rates.
- Motivate citizens to adopt sustainable practices through incentives.
- Partner with local businesses to offer rewards and build a sustainable ecosystem.

1.5 Feasibility and Scope

The future prospects of smart waste management systems with a built-in coupon system are good. As populations of cities expand further, the importance of managing waste efficiently will only increase. These systems can make citizens actively involved in recycling and safe waste disposal by rewarding them for good behavior. This can result in the generation of less waste and higher recycling rates. The viability of such initiatives is also high, particularly with technological progress such as IoT, which simplifies monitoring and data gathering and does so at a reduced cost. Governments and municipalities can adopt such systems at comparatively low start-up costs, particularly if they collaborate with the private sector or utilize grants.

II. LITERATURE REVIEW

2.1 Review of Related Work

[1] IoT-based Dustbin System- Tejashree Kadus, Pawankumar Nirmal, Kartikee Kulkarni

Sensors check the fill level of dustbins and notify a server when full; server assigns workers for collection.

[2] Real-time Waste Management using Smart Dustbins- Jeni Moni, Pramod Mathew Jacob, Shital Pawar

Uses smart dustbins to check fill levels, sending real-time data to reduce unnecessary collection trips.

[3] Smart Garbage Management System- Kellow Pardini , Joel J.P.C. Rodrigues, Ousmane Diallo

Uses IR sensors, microcontrollers, and Wi-Fi for tracking bin status and notifying higher authorities if needed.

[4] Dustbin with Wi-Fi Router- Palak Jain, Taneesha Chaudhary, Sachin Gajjar

Dustbin equipped with PIR sensors and Wi-Fi; users receive temporary internet access for depositing trash.

[5] Proposed Smart Netbin with Shredder and Load Sensor- Mulani Mumtaj Raju, 2Pawar Swapnali Dilip, 3Sawant Sonali Bandopant.

Utilizes a load sensor, shredder, and Wi-Fi module to reward users with internet access upon garbage disposal.

2.2 Summary of Literature Gap

The cited articles concentrate on smart dustbin systems with cutting-edge applications of sensors and connectivity technologies for enhanced waste collection. [1] introduce an IoT-enabled dustbin system in which sensors track fill level and alert a server that allocates workers for picking up. [2] highlight real-time data transmission from intelligent dustbins to streamline collection trips and minimize unnecessary ones. [3] combine IR sensors, microcontrollers, and Wi-Fi to monitor bin status and notify authorities if necessary. [4] propose dustbins with PIR sensors and Wi-Fi, providing users with temporary internet access as a reward for dumping trash. Expanding upon this idea. [5] have suggested a smart net bin model that integrates load sensors, shredders, and Wi-Fi modules to incentivize users with internet connectivity, facilitating waste disposal by means of engaging technology. Together, these articles demonstrate how integrating sensors and wireless communication can bring about efficiency and user interaction within contemporary waste disposal solutions.

III. METHODOLOGY

3.1 Architecture design

The smart waste collection system is centered around the Arduino Uno R4 Minima as the main control unit. The system starts with a user placing waste into a smart bin. A moisture sensor (Robot Soil Moisture Sensor) is utilized to ascertain the percentage of moisture content in the waste to automatically sort into wet and dry compartments. At the same time, an HC-SR04 ultrasonic sensor is used to measure the bin's fill level and determine whether it is full. The Arduino reads information from the sensors and processes it in real time.

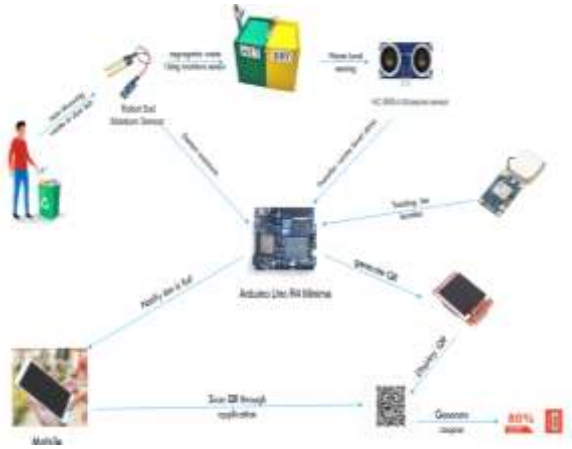


Fig.1 Smart Bin System Architecture

A GPS module is included for location tracking of the bin, allowing officials to track the precise location of every bin. When the bin is filled to its capacity, the Arduino sends a notification to a mobile app, informing both users and city services. The system also has a QR code generator and display module, which gives a unique QR code for every successful waste drop. The users can read this code using the mobile application, which subsequently connects to a coupon system that provides rewards or discounts based on participation. Such an integrated configuration not only incentivizes proper disposal of waste through rewards but also simplifies collection and tracking through automation and real-time processing of data.

3.2 Proposed Design

To design a smart waste management system, four systems are synchronized by the control system. These four systems are: smart bin, control system, mobile phone and server. In addition, to create the control system, two main components are required: Arduino Uno and sensor ultrasonic. Figures 2 and 3 illustrate the kind of components used to manufacture a control system.

3.2.1 Arduino Uno

According to Arduino is a single board micro controlled based on the ATMEGA 328 chip created to process an applied electronics system in multidisciplinary research. The Arduino board was chosen to control and synchronize all systems as it is popular, economical, and easy to implement and is an efficient open-source single board microcontroller. The Arduino has a communication protocol to connect with a computer system. Figure 2 (below) illustrates the Arduino board used in this study.

Fig. 2 NodeMCU Arduino Uno board

3.2.2 Ultrasonic Sensor

Author in sensor is a device which permits the measurement of physical or chemical variables transforming to be an electrical signal. In this study, an ultrasonic sensor was applied to measure the position or level of waste in the bin. This is because the ultrasonic sensor has a high accuracy in millimetres to measure the position and level of physical objects. In addition, ultrasonic sensors are usually used to sense automation to measure distance, position and level. The kind of ultrasonic sensor applied in this research is SRF08, as illustrated in Figure 3 below.

Fig. 3 Ultrasonic sensor SRF08.

3.2.3 Moisture Sensor

A moisture sensor is employed to identify the amount and presence of moisture in waste materials. In smart waste management, this sensor assists in distinguishing between wet and dry waste, which is important for efficient segregation and recycling of waste. The sensor is usually composed of two probes that determine the resistance between them—greater moisture content results in lower resistance and vice versa.

Upon incorporation in smart bins, the moisture sensor provides live readings to the microcontroller (e.g., Arduino Uno), which can proceed to categorize the waste appropriately. This categorization allows proper routing for composting, recycling, or landfill, ultimately contributing to enhanced sustainability and resource recovery. Moreover, proper moisture sensing can avoid odors, minimize contamination, and streamline waste processing operations.

Fig.4 Moisture sensor

3.2.4 lcd display

Fig 5 . 3.5 inch uno lcd display

The 3.5-inch UNO LCD screen is a small, color touchscreen display module that is popularly paired with Arduino Uno boards for simple visual output. It has a 320x480 pixel resolution, providing clear and bright images perfect for the display of QR codes, text, and basic graphics. SPI communication is supported in the display, enabling quick data transfer through minimal wiring. Its touchscreen function allows user interaction on the screen itself. This makes it perfect for demonstrating QR codes in intelligent waste management systems, where customers can scan the code to get coupons or validate waste disposal transactions easily and conveniently.

3.2.5 IR sensor

Fig 6. IR Sensor

3.3V IR sensor is a small infrared sensor module designed for object detection and proximity sensing. It works by emitting infrared light and capturing its reflection from surrounding objects, and therefore can be used for detecting when a user moves near or touches a device. In the context of QR display systems, IR sensor can wake up or display a QR code automatically when an individual is within reach, making the user experience better by saving power and ensuring timely access to the QR code for scanning.

VI. RELATED WORK

4.1 Traditional Waste Management Methods

Traditional waste management systems are highly dependent on manual collection, fixed route schedules, and minimal real-time monitoring. Traditional systems tend to cause over-filled bins, non-optimal routes, and high operational costs. Segregation of waste is minimal in traditional systems, resulting in low recycling rates and environmental risk due to unsafe disposal. Even though they are extensively used, these systems do not scale well, are inflexible, and cannot be optimized using data.

4.2 Smart Waste Management Systems

Recent technology developments in Internet of Things (IoT) revolutionized waste management. Intelligent bins with ultrasonic sensors, weight sensors, and temperature monitors are able to detect fill levels and send notifications to municipal systems. RFID tags and QR codes are employed to monitor user interaction and recognize waste categories.

Intelligent bins exchange information via wireless protocols like Wi-Fi, Zigbee, or LoRaWAN to central databases, facilitating route optimization, predictive maintenance, and real-time status monitoring. The systems are designed to minimize human effort, fuel usage, and environmental footprint while encouraging recycling and data-driven decision-making.

4.3 Use of Incentive Mechanisms in Public Behavior

Behavioral economics prescribes that incentives could easily induce eco-friendly practices. Elements of gamification—like

points, leaderboards, and achievement badges—have been utilized for recycling and energy-saving practices.

Coupon schemes and cashback mechanisms give material rewards to users adopting green practices. Users disposing waste in a proper manner can receive redeemable digital coupons, promoting long-term interaction. Such mechanisms entwine psychology, technology, and city governance to alter behavior positively.

V. IMPLEMENTATION

5.1 System Diagrams

5.1.1 State Diagram:

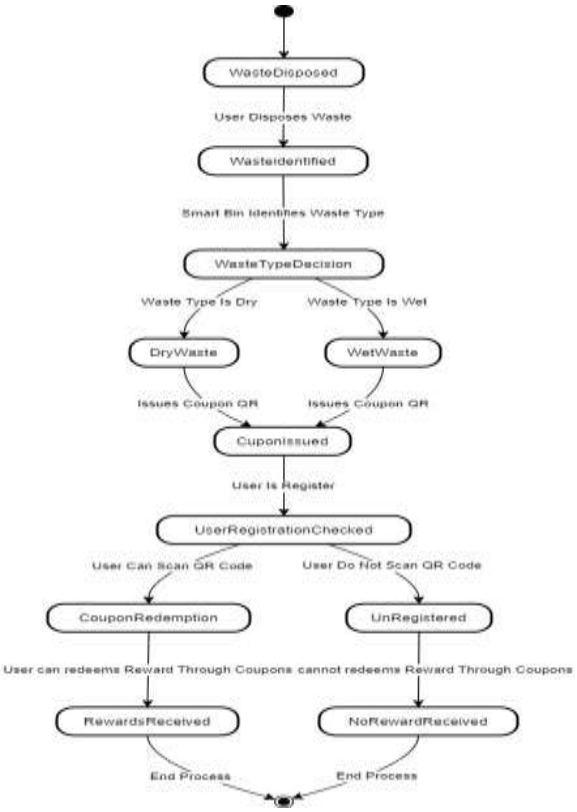


Fig 6. Smart Bin State Diagram

5.1.2 Component Diagram

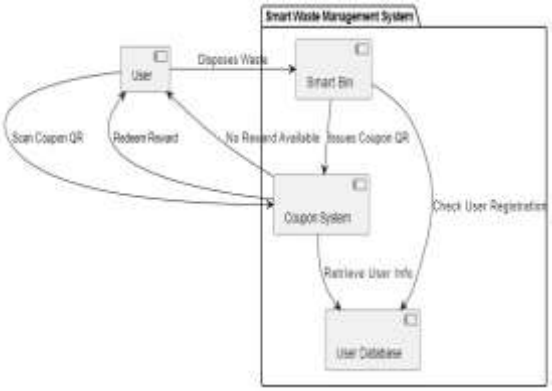


Fig 7. Smart Bin Component Diagram

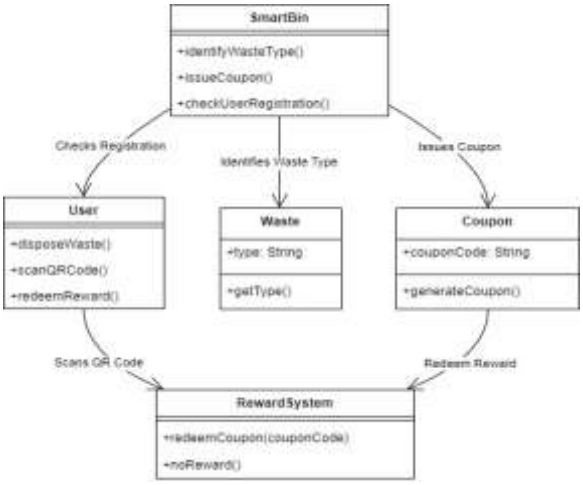
5.2 System Work Flow

- Waste Disposed – User puts waste into smart bin.
- Waste Identified – System identifies the presence of waste.
- Waste Type Decision – Smart bin determines if the waste is dry or wet.
- Coupon Issued – A QR coupon is issued based on the type of waste and is shown.
- User Registration Check – System verifies if the user is registered.
- QR Code Scanned
- If Scanned → User redeems coupon → Rewards Received.
- If Not Scanned or user not registered → No Reward Received.
- End Process – The process ends whether reward is given or not.

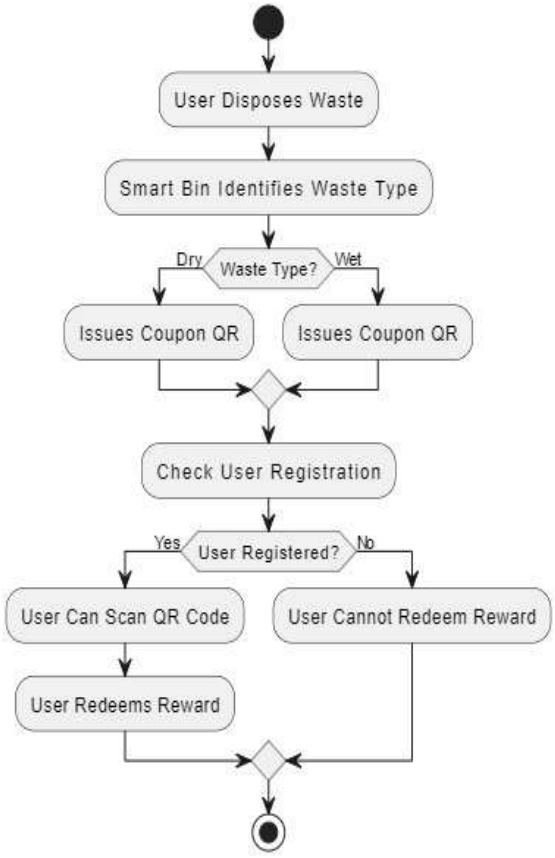
5.3 User Interface Work Flow

- Login Page or Registration Page - User opens app and adds necessary details.
- QR scanner Page – User scans QR code form display screen.
- Coupon Page – User receives the coupon.
- History Page – User can seen previous coupon data.

6.1 Class Diagram

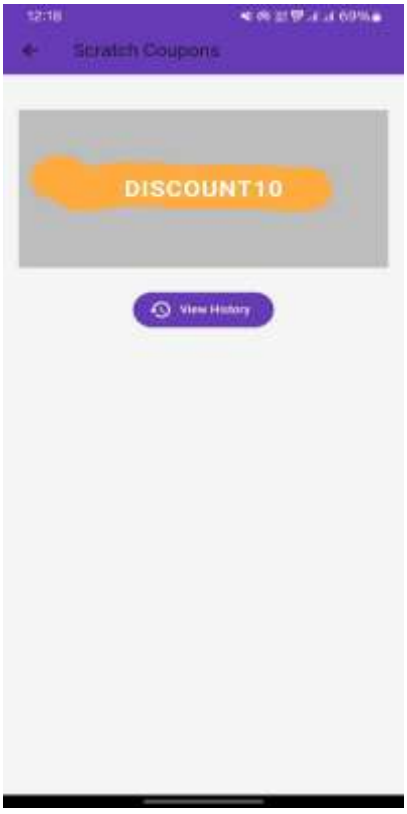


6.2 Activity Diagram



VI. RESULT AND DISCUSSION

Click To Get Coupon


Scratch Coupons
DISCOUNT10
View History

VI. CONCLUSION

In summary, the Smart Waste Management using a Coupon System project presents a practical and innovative approach to addressing urban waste disposal issues. Through the incentive of redeemable coupons for proper waste disposal, the system not only rewards cleaner public environments but also engages active community participation in waste management. Through IoT-enabled monitoring, efficient collection routing, and real-time data, this system enhances waste management operations while promoting a cleaner, healthier, and more sustainable environment. In the end, the project illustrates how technology and reward-based systems can collaborate to revolutionize urban waste management.

VII. REFERENCES

1. D. Tonini, P. F. Albizzati, and T. F. Astrup, "Environmental impacts of food waste: Learnings and challenges from a case study on UK," Waste Management, vol. 76, pp.744-766, 2018.
2. D. Leverenz, G. Hafner, S. Moussawel, M. Kranert, Y. Goossens, and T. Schmidt, "Reducing food waste in hotel kitchens based on self reported data," Industrial Marketing Management, vol. 2020.
3. Y. Fukaya, M. Goto, H. Ohashi, T. Nishihara, Y. Tsubata, and T.Matsumura, "Optimization of disposal method and scenario to Reduce High Level Waste Volume and Repository Footprint for HTGR," Annals of Nuclear Energy, vol. 116, pp.224-234, 2018.
4. S. Narayanamoorthy, V. Annapoorani, D. Kang, D. Baleanu, J. Jeon, J. V. Kureethara, and L. Ramya, "A novel assessment of bio-medical waste disposal methods using integrating weighting approach and hesitant fuzzy MOOSRA," Journal of Cleaner Production, vol. 275, 2020.
5. A. T. Gebremariam, F. D. Maio, A. Vahidi, and P. Rem, "Innovative technologies for recycling End-of-Life concrete waste in the built environment," Resources, Conservation and Recycling, vol. 163, 2020.
6. A. E. Schwarz, T. N. Ligthart, D. G. Bizarro, P.D. Wild, B. Vreugdenhil, and T. V. Harmelen, "Plastic recycling in a circular economy; determining environmental performance through an LCA matrix model approach," Waste Management, vol. 121, pp.331-342, 2021.
7. M. W.Rahman, R. Islam, A. Hasan, N. I. Bithi, M.M. Hasan, and M. M. Rahman, "Intelligent waste management system using deep learning with IoT," Journal of King Saud University - Computer and Information Sciences, vol. 2020.