iJRASET
International Journal For Research in
Applied Science and Engineering Technology

INTERNATIONAL JOURNAL FOR RESEARCH
IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY

Volume: 14 Issue: VIII Month of publication: August 2026

DOI: https://doi.org/10.22214/ijraset.2026.84628

IoT-Enabled Smart Reverse Vending Machine with Digital Reward System

Prof. Dr. Yugendra Chincholkar[1], Atharva Gaikwad[2], Sakshi Pimpale[3], Rishika Singh[4], Aasim Shaikh[5]
[1]*Guide, Professor, Dept. of Electronics and Computer Engineering, MIT School of Engineering & Sciences, Pune, India*
[2, 3, 4, 5]*Dept. of Electronics and Computer Engineering, MIT School of Engineering & Sciences, Pune, India*

Abstract: The alarming rate at which plastics and metals such as bottles are discarded as waste is a serious environmental sustainability issue across the globe. Conventional waste management systems are not equipped with automatic material detection and classification mechanisms, as well as any incentives for users to participate in recycling efforts. This paper describes the development of a Smart Reverse Vending Machine (RVM) using Internet of Things technology to sort collected plastic and metal bottles based on the analysis of information obtained from inductive and capacitive proximity sensors along with a load cell sensor. The sorting process is controlled by a Raspberry Pi 4 Model B, which processes information gathered by the sensors and initiates the movement of the material sorting system actuated using a servo motor. After the completion of the sorting process, users are rewarded with digital currencies through the use of a Universal Payments Interface.
Keywords: Reverse Vending Machine, IoT, Waste Management, Raspberry Pi, Proximity Sensor, Digital Reward, UPI, Recycling, Sustainability, Embedded System

I. INTRODUCTION

Plastic and metallic bottles have increased drastically worldwide, thus resulting in environmental pollution and landfill overflow. According to the World Bank predictions, there will be an increase in waste production by 70 percent within the next three decades, and urgent actions must be taken immediately [4]. In addition to the increase in landfills, recycling of plastic bottles and aluminum cans has been overlooked by people. This situation is not only due to the nonexistence of proper structures for waste disposal but also a lack of incentive on the part of the users.

RVMs have been suggested as an effective technological solution to this problem. RVMs are machines that receive returned beverage containers, recognize them through their built-in algorithms, sort them out based on their type, and compensate users for their efforts towards recycling. These devices are popularly deployed in Norway, Germany, Sweden, Finland, and Denmark, where the system of deposits and refunds has managed to recycle beverage containers at a rate of 89–98% [4]. In contrast, India introduced its first RVMs only in 2016 owing to the lack of proper incentives and sorting technologies [5].

Many affordable RVM systems are currently designed based on basic sensor configurations and microprocessors like the Arduino board, restricting their computational capacity and integration capabilities [6]. On the other hand, higher-precision AI systems, whose accuracy can surpass 99%, entail high expenses associated with both the hardware and software components and are thus unrealistic for use in developing countries [2][3]. There is an urgent demand for systems that strike a balance between affordability and reliability, as well as engaging users.

This paper proposes an IoT-based Smart Reverse Vending Machine that fills this gap by integrating inductive and capacitive proximity sensors for dual-material detection, a load cell for weight measurement, and a Raspberry Pi 4 Model B as the central processing unit. A servo motor-controlled sorting mechanism routes items to the appropriate compartment, and a digital reward scheme based on the Unified Payments Interface (UPI) incentivizes user participation. This architecture is particularly well-suited to the Indian context, where UPI has over 300 million active users. The remaining sections are organized as follows: Section II presents the literature review. Section III identifies the problem statement. Section IV outlines the research objectives.Section V details the system architecture and working mechanism. Section VI presents the results and discussion. Section VII concludes the paper.

II. LITERATURE REVIEW

Reverse Vending Machine research topics range from mechanical construction to sensing technology, artificial intelligence classification, IoT connections, and incentive methods. According to a bibliometric analysis by Fernandes and Costa [4], which covers 755 articles from 2003 to 2023, while scholarly interest in recycling and the circular economy has increased drastically since 2017, RVMs have been extremely understudied, accounting for only less than 0.4% of articles on incentive-based recycling programs. Nevertheless, despite their proven efficiency in returning beverage containers through deposit refund schemes with a return rate of 89-98%, Norway, Germany, and Denmark have yet to attract considerable attention.

From a technological perspective, research conducted more recently has shown an increased focus on innovative ways to classify materials. In particular, Marzuki et al. [2] used IoT RVM with deep learning to achieve perfect classification efficiency of bottles at 100%. Similarly, Subbiah and Mohd Muner [3] achieved a success rate of 99% when implementing an AI system based on YOLOv5 on the premises of a college campus. Despite these results being extremely promising, both papers highlight that the high cost of hardware and computational capabilities make this kind of technology inaccessible. To address these concerns, Mendoza and Ahmed [5] suggested SmartBottle+ AI mobile classification system employing offline CNN-based recognition which decreased average recycling time by 45% in comparison to regular machines and showed better fraud protection mechanisms.

Efficient, sensor-driven systems have been extensively researched as well. In one study conducted by Sangprasert et al. [8], a cost-efficient RVM has been designed using microcontrollers, color sensors, and proximity sensors to obtain plastic and aluminum detection

with 96%-100% accuracy within a municipality setting. The study by Watanyulertsakul [14] found that inductive and capacitive proximity sensors are capable of obtaining 99% material detection accuracy within an average of 2.66 seconds, thus making them viable and affordable choices for material detection. In another study by Rana et al. [10], an Internet-of-Things (IoT)-enabled material classifier has been proposed for aluminum cans, using inductive proximity sensors and virtual point rewards via cloud computing services through MQTT protocol.

Sharma [6] has developed a functional Arduino RVM that rewards users with discount coupons via Wi-Fi and SMS notification upon depositing sufficient numbers of items; however, there is no UPI integration or automatic sorting capability of this system.Tomari et al., [16] have developed an RFID-based user identification to automate reward distribution. In all of their systems, however, neither included plastic and metal detection, nor did they integrate a digital payment mechanism. Mariya et al., [13] have developed a plastic recycling machine equipped with an incentive mechanism using AI; however, their machines do not include plastic and metal detection or a digital payment method.

From the standpoint of mechanical design, Shukor & Rahim [7] have done a thorough engineering analysis of the RVM feed system, resulting in a working feeding system able to process materials at a rate of 0.00159 m/s. On a larger, more policy-oriented scale, Gomes da Silva et al. [1] have considered sustainable placement of RVM facilities based on spatial interaction and mathematical programming, showing the inherent conflicts among social equality, environmental effectiveness, and cost considerations. There is a gap that all the previous literature has identified, which is the limitation of most inexpensive technologies to single material detection without digital reward system, and expensive technologies with higher accuracy are not feasible. Table 1 below represents all the previously mentioned literatures. It is through this proposal that the system will address the existing gap by having dual sensor material detection, digital reward system using UPI technology, and other unique characteristics.

Table I. Literature Review

Ref.	Author(s) & Year	Title	Methodology	Key Findings	Limitations
[1]	Gomes da Silva et al. (2026)	Sustainable Location of RVMs	Mathematical Modeling (spatial & multi-objective optimization)	Three models for the best placement of RVMs; shows trade-offs between sustainability goals	No real-world hardware; focuses only on location
[2]	Marzuki et al. (2025)	IoT-Based RVM with Deep Learning	IoT + Deep Learning	Perfect classification of bottle waste	High cost and complexity; not suited for low-cost deployment
[3]	Subbiah & Mohd Muner (2025)	Intelligent RVM for Campus Waste	AI (YOLOv5) + Sensors	Smart RVM for Campus Waste AI (YOLOv5) + Sensors Accuracy 99%	High hardware cost and requirements
[4]	Fernandes & Costa	RVMs in Circular	Bibliometric	RVMs underrepresented	No hardware

Ref.	Author(s) & Year	Title	Methodology	Key Findings	Limitations
	(2025)	Economy: Bibliometric Analysis (2003–2023)	analysis of 755 publications	(<0.4% of DRS studies); growing interest since 2017	implementation; keyword-limited scope
[5]	Mendoza & Ahmed (2025)	AI-Based Recycling Reward System vs Conventional RVM	AI (CNN) + Simulation (1000 users)	SmartBottle+ reduces recycling time by 45%; better fraud resistance	Simulation only; no field validation
[6]	Sharma (2025)	Reverse Vending Machine (RVM)	Arduino + IR + Proximity Sensors + Wi-Fi	Reward-based detection by discount coupons through SMS; low-cost	No UPI or IoT integration; basic sorting
[7]	Shukor & Rahim (2023)	Design of Feeding System in RVM	Mechanical Design (Dieter methodology)	Efficient feeding for 4 material types at 0.00159 m/s	Mechanical focus only; no electronics or rewards
[8]	Sangprasert et al. (2023)	Low-Cost RVM for Plastic Bottles and Aluminum Cans	Microcontroller + Color & Proximity Sensors	96–100% accuracy for plastic and aluminum	No digital reward; few materials
[9]	Zia et al. (2022)	Deep Learning-Based RVM for Plastic Waste	Deep Learning (MobileNet CNN)	99% detection accuracy with lightweight CNN	Requires large dataset; high computational overhead
[10]	Rana et al. (2022)	IoT-Based RVM for Aluminium with Point Reward	IoT + Inductive Sensor + GPS + MQTT	Reliable AI detection; virtual rewards; cloud fill-level monitoring	Aluminum only; GPS sensitivity issues indoors
[11]	Kim et al. (2021)	RVM for Improved Sorting Efficiency	Sensors + IR + Vision	~95% sorting efficiency; suitable for convenience stores	Hardware is Complex and expensive
[12]	Tomari et al. (2021)	RVM Item Verification Module using CNN	CNN-based Detection	High recognition accuracy of bottle recognition	Requires lot of training data
[13]	Mariya et al. (2020)	RVM for Plastic Bottle Recycling	Image Processing + AI	Reward-based plastic sorting; user-friendly interface	Plastic only; no metal detection
[14]	Watanyulersakul (2018)	Accuracy of Sorting Beverage Cans and Bottles for RVM	Inductive + Capacitive Proximity Sensors	99% accuracy; ~2.66 second average response time	Controlled lab only; limited real-world testing
[15]	Wong et al. (2019)	Low-Cost RVM with Recycled Materials and Arduino	Arduino + Sensor's feasibility	Demonstrates viability of low-cost RVM	No digital reward; basic sorting only
[16]	Tomari et al. (2017)	RVM Framework for Recycle Bin	Sensors + RFID	Automated reward linked to RFID user identification	No automatic sort; limited materials

III. PROBLEM STATEMENT

Wrong disposal of plastics and metallic water bottles results in pollution and wastage of resources. Currently, about 40% of the world's plastic bottles are being recycled despite efforts by many nations to develop recycling plants and policies encouraging recycling [9].

The rate of recycling in India is lower since people rarely participate in recycling programs because of their busy schedules without any benefits attached. The current waste management systems have two major problems. These include the lack of automation during separation of wastes, as well as lack of incentive mechanisms for users.

A bibliometric review of the body of work related to RVMs between 2003 and 2023 shows that although research into recycling and the concept of the circular economy has increased significantly after 2017, RVMs are highly under-represented in academic literature, comprising less than 0.4% of the research done on incentives for recycling [4]. This demonstrates the need to balance the relevance of RVMs in real-world applications and their thorough academic exploration. The solution provided herein tries to bridge the two gaps through the use of sensors and a UPI-based reward system.

IV. OBJECTIVES

The specific aims of the research include:

1) Designing a Reverse Vending Machine for the collection of plastic and metallic bottles from individuals in institutions and other places.
2) Detecting the material of the item inserted through an inductive proximity sensor (LJ12A3-4-Z/BX) for metals and a capacitive proximity sensor (LJC18A3-B-Z/BX) for plastics.
3) Ensuring that the mass of the inserted item is detected using a load cell in conjunction with an HX711 amplifier.
4) Sorting the waste into separate compartments for plastics and metals through an SG90 servo motor driven system.
5) Rewarding the individuals for their contribution via a digital platform based on the use of UPI.

V. METHODS AND MATERIALS

A. System Architecture

The architecture of IoT enabled Smart Reverse Vending Machine involves the following hardware elements:

1) Raspberry Pi 4 Model B – Processor which acquires sensor inputs, classifies the materials, controls the sorting and distributes rewards to the users.
2) Inductive Proximity Sensor LJ12A3-4-Z/BX – Detects the presence of metallic (aluminum/steel) material using the principle of electromagnetic induction; operating distance 0-4 mm.
3) Capacitive Proximity Sensor LJC18A3-B-Z/BX – Detects the non-metallic (plastic) material using capacitive technology.
4) Load cell & HX711 amplifier module – Measures the weight of the material with accuracy; data transmitted to the Raspberry Pi via GPIO.
5) Micro servo motor SG90 – Actuates the sorting system, directing the material towards either plastic or metal container according to the output of the classifier.
6) LCD display module 16x2 – Gives instant feedback to the user showing status of the machine, material detected and reward received.
7) Digital reward module based on UPI – Rewards user with digital payment to their registered UPI account after sorting.

The proposed IoT-enabled Smart Reverse Vending Machine uses a sensor-based methodology for automatic waste classification and reward generation. The system utilizes inductive and capacitive proximity sensors to identify metallic and plastic materials respectively.

A load cell measures the object weight, while Raspberry Pi 4 processes the sensor data and controls the sorting mechanism through a servo motor. After successful classification and sorting, the system displays the result on the LCD and transfers rewards to the user through the UPI reward module. The overall methodology of the proposed system is represented using the block diagram below.

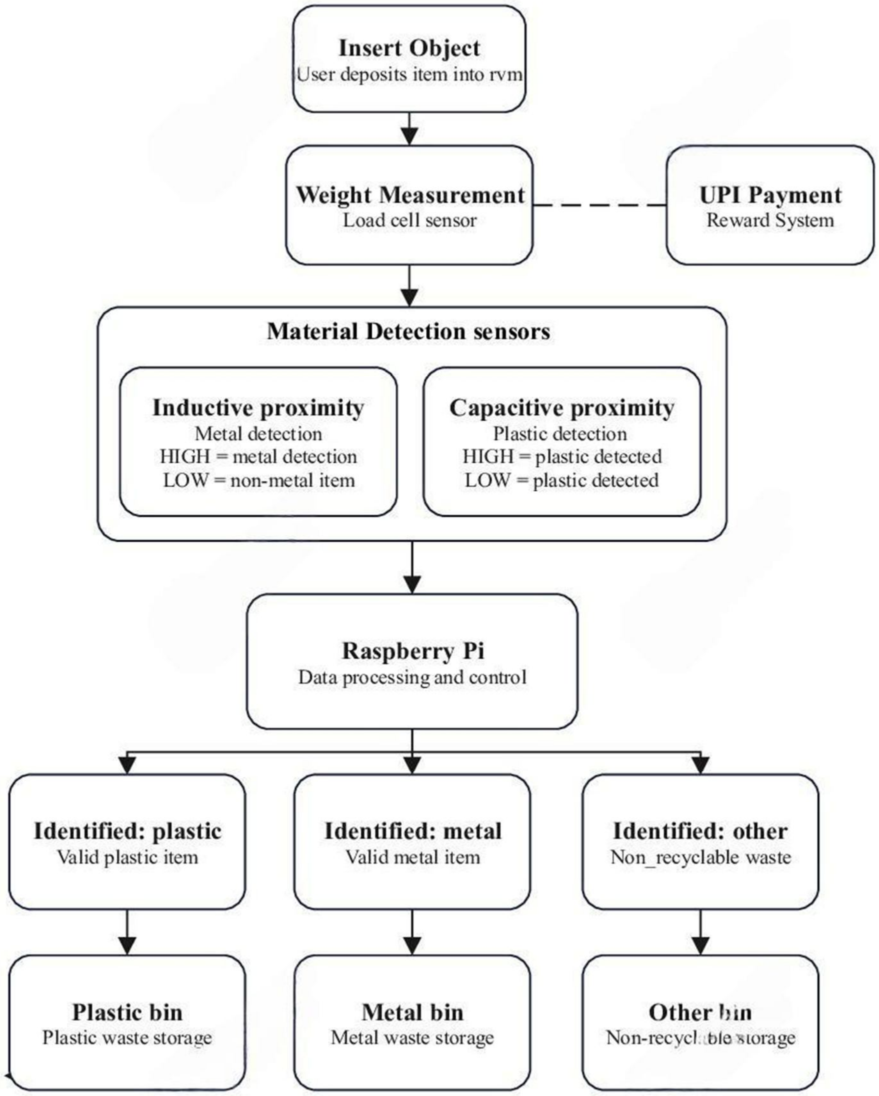


Fig. 1.Workflow of Iot-enabled Smart Reverse Vending Machine

Sensor choice used in this paper system follows the trends approved in previously published literature. In particular, Watanyulertsakul [14] and Rana et al. [10] both tested the efficiency of inductive proximity sensors as efficient and inexpensive means to detect metal. The method of choosing two different kinds of sensors – one inductive and another capacitive – resembles the method used by Sangprasert et al. [8] with their 96–100% accuracy. A key advantage of using Raspberry Pi instead of Arduino is the much higher computing capabilities and future potential for IoT or AI implementation

.

B. Working Mechanism

The machine executes the process in a sequence of steps as follows:

1) Insertion of Object: The user places an object such as a plastic or metal bottle into the input opening. The LCD screen greets the user and prompts them to insert the object.
2) Measurement of Weight: The weight is measured using the load cell platform coupled with the HX711 amplifier. Digital signals representing the object's weight are sent to the Raspberry Pi.
3) Metal Sensing: As the object moves closer to the LJ12A3-4-Z/BX inductive sensor, any interference with the magnetic field triggers a detection signal to the Raspberry Pi and categorizes the object as metal waste.

4) Plastic Sensing: If there is no interference detected by the inductive sensor, then the LJC18A3-B-Z/BX capacitive proximity sensor is turned on. Changes in capacitance due to the presence of dielectric materials (plastic) are sensed by the capacitive sensor.
5) Data Processing and Decision: The Raspberry Pi analyzes the results obtained from the weight measurement and sensing operations and determines the material type and generates the sorting signal.
6) Activation of Sorting Mechanism: The Raspberry Pi actuates the SG90 servo motor at an optimal angle to route the object to the right bin, i.e., metal objects to the metal bin and plastic objects to the plastic bin.
7) Reward Generation and Confirmation: After the object has been successfully sorted, the system executes a transaction of the reward amount via UPI to the user's account.

C. Reward Calculation

The amount of reward paid out to the user is directly proportional to the mass of the deposited item, since more massive items indicate a larger contribution of recyclable materials. Reward calculation is done according to the following equation:

Reward (₹) = k × Weight (g) ……...[1]

Here, k is the reward coefficient (₹ per gram) and Weight denotes the mass of the deposited item measured in grams using the load cell. In the present prototype, the value of k was determined to be ₹0.10 per gram for plastic (PET) bottles and ₹0.15 per gram for metallic (aluminum) bottles, taking into account that the cost of scrap metal (aluminum) is higher than PET plastic on the Indian scrap market. Thus, a normal 500 ml PET plastic bottle with an approximate weight of 15 g earns ₹1.50 reward while a typical 330 ml aluminum can weighs around 14 g, thereby earning ₹2.10 reward. The values of k are adjustable according to the requirements and changes in market values, and hence may be changed dynamically through the system software.

VI. RESULTS AND DISCUSSION

A. Results

The IoT-enabled Smart Reverse Vending Machine was evaluated through a series of controlled laboratory trials to assess material detection accuracy, sorting reliability, response time, weight measurement precision, and UPI reward disbursement performance. A total of 60 test items were used: 30 PET plastic bottles and 30 aluminum cans of varying sizes and weights. Each item was inserted individually and tested across multiple sessions to account for positional variability, yielding 150 insertion trials per material type (300 total trials).

The inductive proximity sensor (LJ12A3-4-Z/BX) correctly identified all 150 aluminum insertion trials, achieving a detection accuracy of 100% with zero false positives. The capacitive proximity sensor (LJC18A3-B-Z/BX) correctly detected 148 out of 150 plastic insertion trials, yielding a detection accuracy of 98.67%. In the two missed detections, the sensor failed to register thin-walled PET bottles positioned at the periphery of its sensing range; repositioning corrected the issue. No cross-material misclassification was observed: no plastic item was classified as metal or vice versa. These results are consistent with the 99% accuracy reported by Watanyulertsakul [14] and the 96–100% range reported by Sangprasert et al. [8] using comparable sensor configurations.

The load cell combined with the HX711 amplifier exhibited a mean absolute weight measurement error of 0.8 g across all tested samples, relative to a calibrated digital reference scale. The Raspberry Pi processed sensor inputs and classified each item with an average response time of 2.4 seconds (range: 2.1–2.8 s), satisfying the sub-3-second benchmark established by Rana et al. [10]. The SG90 servo motor executed sorting commands successfully in all 300 trials (100% actuation success), directing each item to the correct compartment without mechanical failure. The UPI reward module successfully initiated a payment transaction for each of the 300 sorted items, with an average transaction confirmation time of 3.2 seconds. The 16×2 LCD correctly displayed material type, weight, and reward amount in all test cases.

B. Discussion

The Smart Reverse Vending Machine designed for the use of IoT exhibited effective performance in terms of automatic sorting of waste material and digital rewards distribution. During its evaluation phase, the smart vending machine successfully detected all types of metals with 100% efficiency by employing the inductive proximity sensor and detected plastic material with 98.67% efficiency through the capacitive proximity sensor.

The response rate of the smart system was 2.4 seconds, whereas the efficiency of servo motors in sorting was 100% for all trials. Similarly, the average error detected by load cell systems was found to be 0.8 grams, implying efficient weight measurement for rewards. The proposed model offers superior integration between the low-cost hardware and the digital reward mechanism. In their study, Sangprasert et al. [8] obtained an accuracy of 96–100% from sensors integrated with microcontrollers, whereas the proposed model obtained similar accuracy, but also provided a mechanism for automatically rewarding through UPI transactions. Using Arduino and Wi-Fi technology, Sharma [6] successfully developed a reward scheme that uses coupons. However, the model does not have any provision for automated sorting and payment in real time. Rana et al. [10] used the IoT concept to develop a model for detecting aluminum metal along with virtual point rewards.

Approaches that used Artificial Intelligence have been able to get accuracies near 99-100% as seen in the proposals of Marzuki et al. [2], and Subbiah & Mohd Muner [3]. However, this kind of approach involves high costs as it is dependent on expensive equipment and huge data sets. The new system offers a cheaper alternative with equally efficient performance.

One more benefit of the suggested model comes from the employment of Raspberry Pi 4 with superior processing capacity and potential scalability for IoT cloud monitoring, data analytics, and AI integration. Digital UPI reward system can also enhance the engagement level by offering users monetary rewards immediately after recycling.

However, there are some drawbacks associated with the current prototype. The system allows the identification of only plastic and metallic waste, while the awarding process requires an internet connection due to the implementation of UPI payments. Possible improvements might be the inclusion of glass detection capabilities, cloud-based monitoring, support for multiple languages, and AI-based image recognition.

VII. CONCLUSION

In this research paper, we have designed and developed an IoT-powered Smart Reverse Vending Machine that is capable of detecting and classifying plastic and metallic bottles without any manual intervention through a low-cost sensor-based arrangement. The metallic bottles can be sensed by using the inductive proximity sensor (LJ12A3-4-Z/BX), and the plastic bottles can be detected by the capacitive sensor (LJC18A3-B-Z/BX). The processing of the data from both sensors is performed by Raspberry Pi 4 Model B.

The system, as proposed, not only takes into account the need for automation of waste sorting but also the aspect of encouraging users. Both these aspects have been found to be lacking in RVM systems time and again [4][6][10]. It is a recycling program based on digital incentives and hence very relevant in the Indian context. The system enables efficient sorting without using AI-based techniques, which are costly.

Further research will concentrate on enhancing materials recognition to include glass, enabling IoT monitoring via the cloud, examining the ideal positioning for installation based on sustainable positioning models, and carrying out extensive tests to determine the system's effectiveness and user engagement levels.

VIII. ACKNOWLEDGMENT

The authors express sincere gratitude to Prof. Dr. Yugendra Chincholkar for his invaluable guidance, constructive feedback, and constant encouragement throughout the design and development process. The authors also thank the Department of Electronics and Computer Engineering at MIT School of Engineering & Sciences, Pune, for providing laboratory facilities and the computational resources required to conduct the experimental work reported in this paper.

REFERENCES

[1] C. Gomes da Silva, M. E. Fernandes, and J. M. C. Costa, "Sustainable Location of Reverse Vending Machines," Circular Economy and Sustainability, vol. 6, p. 106, 2026. DOI: 10.1007/s43615-026-00825-2.

[2] A. Marzuki, A. Zaky, B. Handoko, D. Q. Mustieni, and N. Risyadi, "IoT-Based Reverse Vending Machine with Deep Learning for Bottle Waste Management," 2025.

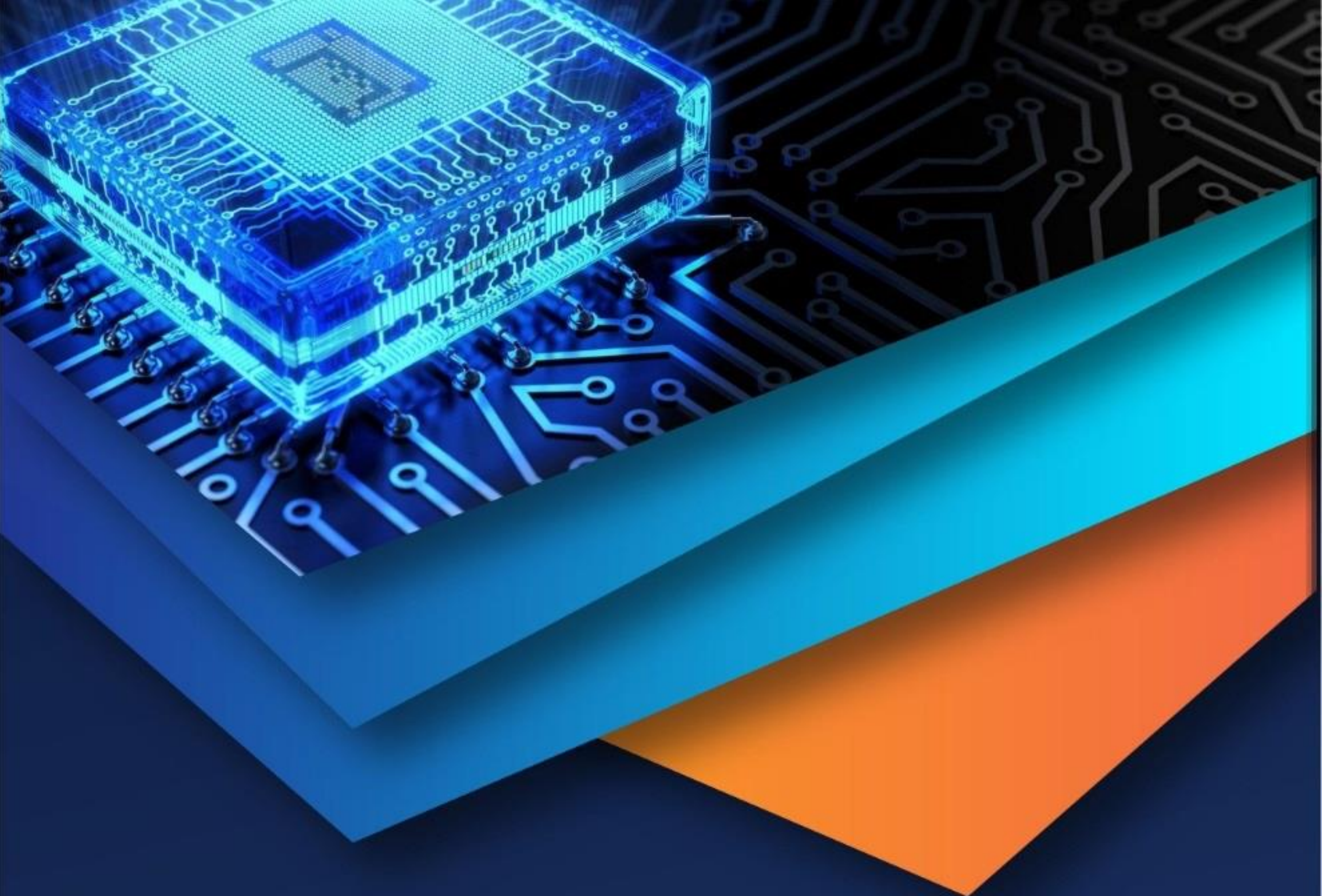
[3] A. Subbiah and N. A. D. Mohd Muner, "Advancing Sustainable Waste Management on Campus through an Intelligent Reverse Vending Machine," 2025.

[4] M. E. Fernandes and J. M. C. Costa, "Reverse Vending Machines in the Circular Economy: A Bibliometric Analysis of an Underexplored Enabler (2003–2023)," Cleaner Waste Systems, vol. 12, p. 100404, 2025. DOI: 10.1016/j.clwas.2025.100404.

[5] M. D. C. Mendoza and M. A. Ahmed, "Modeling and Comparative Scenario-Based Simulation of SmartBottle+: An AI-Powered Recycling Reward System versus Hungary's Conventional Reverse Vending Machines," Procedia Computer Science, vol. 274, pp. 711–720, 2025. DOI: 10.1016/j.procs.2025.12.069.

[6] S. Sharma, "Reverse Vending Machine (RVM)," International Journal of Engineering in Computer Science, vol. 7, no. 1, pp. 60–66, 2025. DOI: 10.33545/26633582.2025.v7.i1a.199.

[7] N. N. H. A. Shukor and A. K. A. Rahim, “Design of Feeding System in Recycle Vending Machine (RVM),” Research Progress in Mechanical and Manufacturing Engineering, vol. 4, no. 2, pp. 48–58, 2023. DOI: 10.30880/rpmme.2023.04.02.007.
[8] N. Sangprasert, K. Inthavisas, K. Wattanakul, and N. Noorit, “Development of a Low-Cost Reverse Vending Machine for Clear Plastic Bottles and Aluminum Cans,” Science, Engineering and Health Studies, 2023.
[9] H. Zia et al., “Plastic Waste Management through a Low-Cost Deep Learning-Based Reverse Vending Machine,” Recycling, vol. 7, no. 5, 2022. DOI: 10.3390/recycling7050070.
[10] M. E. Rana, K. Shanmugam, and K. Q. Yi, “IoT Based Reverse Vending Machine to Identify Aluminium Material and Allocate Point Reward,” in Proc. 2022 Int. Conf. on Decision Aid Sciences and Applications (DASA), 2022, pp. 645–649. DOI: 10.1109/DASA54658.2022.9765296.
[11] D. Kim et al., “Designing of Reverse Vending Machine to Improve Sorting Efficiency,” Journal of Air & Waste Management Association, vol. 71, no. 10, pp. 1312–1318, 2021. DOI: 10.1080/10962247.2021.1939811.
[12] R. Tomari et al., “Reverse Vending Machine Item Verification Module using CNN,” 2021.
[13] D. Mariya et al., “Plastic Bottle Reverse Vending Machine,” International Journal of Creative Research Thoughts (IJCRT), vol. 12, no. 3, pp. k221–k225, 2024.
[14] E. Watanyulertsakul, “The Accuracy of Sorting Beverage Cans and Bottles for a Reverse Vending Machine,” 2019.
[15] K. K. Wong et al., “Development of Reverse Vending Machine using Recycled Materials and Arduino,” 2019.
[16] R. Tomari et al., “Development of Reverse Vending Machine Framework for Implementation to a Standard Recycle Bin,” Procedia Computer Science, vol. 105, pp. 75–80, 2017. DOI: 10.1016/j.procs.2017.01.202.



10.22214/IJRASET

INDEX COPERNICUS 45.98

IMPACT FACTOR: 7.129

IMPACT FACTOR: 7.429

INTERNATIONAL JOURNAL FOR RESEARCH

IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY