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ECO VEND-PLASTIC RECYCLING REWARD MACHINE

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Abstract:

Eco Vend is a smart vending machine that promotes plastic recycling by rewarding users with points for depositing plastic bottles. It integrates an ESP32 microcontroller, capacitive sensor, and OLED display to detect bottles and generate a QR code, which users scan via a web app to claim rewards. The system features secure authentication, QR code

Keywords **—ECO, VEND, PLASTIC, RECYCLING, REWARD MACHINE.**

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Introduction

Eco Vend is an innovative and eco-friendly smart vending machine designed to encourage responsible waste disposal by rewarding users for recycling plastic bottles. The system utilizes advanced hardware and software integration to provide a seamless recycling experience, reducing plastic waste and promoting sustainable habits.

The core idea behind Eco Vend is to motivate individuals to recycle by offering tangible incentives. Users deposit plastic bottles into the machine, which then verifies the deposit and generates a unique QR code. By scanning this QR code through a dedicated web application, users can accumulate reward points, which can later be redeemed for various benefits. This initiative not only contributes to environmental conservation but also fosters an incentive-based recycling culture

System Components

Eco Vend consists of two primary components:

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Vending Machine System:

This hardware-based module includes sensors to detect plastic bottles, a microcontroller for processing, and a display for user interaction.

Web Application:

A digital interface that allows users to scan the QR code, validate transactions, and monitor their reward points.

System Overview

Eco Vend integrates both hardware and software components to ensure smooth operation and a user- friendly experience. The system is designed for reliability, efficiency, and scalability, making it suitable for public spaces like shopping malls, parks, and educational institutions.

Hardware Components

The vending machine system includes the following essential hardware:

1. ESP32 Microcontroller
2. Capacitive Sensor
3. OLED Display
4. LED Indicator

ESP32 Microcontroller

Serves as the central processing unit, managing sensor input, QR code generation, and communication with the backend system.

Offers Wi-Fi and Bluetooth capabilities for seamless connectivity.

Capacitive Sensor

A capacitive sensor detects plastic by sensing its electrical properties. Every material has a unique ability to store electric charge, called dielectric constant. Plastic has a different dielectric constant than metals, glass, or wood.

When a plastic object comes near the sensor, it changes the electric field, allowing the sensor to recognize it. Since plastic has a lower conductivity than metals, capacitive sensors can easily distinguish plastic from metal objects.

OLED Display

Displays the generated QR code for users to scan Provides basic system messages such as confirmation of bottle detection.

LED Indicator

Offers visual feedback, such as blinking when a bottle is detected and solid light when a QR code is ready.

Software Components

Eco Vend employs a robust software infrastructure for backend processing, user authentication, and data management.

Frontend(React Web Application)

A responsive user interface that allows users to scan QR codes, track accumulated reward points, and redeem rewards.

Supports a mobile-friendly design for convenient access.

Backend (Django API)

Manages authentication, QR code validation, and reward point allocation. Ensures data security and prevents fraudulent transactions.

3. Database (SQL-based Storage)

Stores user details, QR code transactions, and reward history. Ensures structured data management for seamless tracking and retrieval

Features & System Enhancements

Core Features-Eco Vend offers the following primary features to ensure an efficient recycling process:

QR Code Generation

Each time a plastic bottle is inserted, the ESP32 microcontroller generates a unique QR code. The QR code is displayed on the OLED screen for scanning.

QR Code Scanning & Validation

Users scan the QR code using the web application, which verifies its authenticity. The system prevents duplicate scans for a single QR code.

Reward System

Users earn reward points for each valid QR code scan.

The points can be redeemed for various incentives, such as discounts, vouchers, or donations to environmental causes.

Phone Number

Authentication Ensures secure and unique user identification by requiring phone number-based login. Helps prevent duplicate or fraudulent accounts.

QR Code Expiration

Each QR code is valid for a single transaction and expires after a predefined period. Prevents unauthorized use or duplication of QR codes.

System Enhancements

To improve efficiency and usability, several enhancements have been incorporated into the Eco Vend system:

Temporary QR Code Storage

The system temporarily stores generated QR codes and their corresponding timestamps.

If a QR code is not scanned within a certain timeframe, it is automatically invalidated.

Automated Error Detection

The system can detect and handle errors such as sensor malfunctions or connectivity issues.

If a plastic bottle is not detected properly, an error message is displayed.

Cloud-Based Data Storage

In addition to local storage, Eco Vend integrates cloud storage for backup and remote monitoring. Enables administrators to analyse usage patterns and optimize machine performance

Multi-Language Support

The web application supports multiple languages to cater to diverse user demographics.

Enhances accessibility and usability in different regions

Machine Learning for bottle Identification

Future versions of EcoVend may include machine learning-based image recognition to distinguish plastic bottles from other waste materials.

Helps prevent misuse and improves accuracy.

Conclusion

Eco Vend is a sustainable and user-friendly recycling solution that combines technology with environmental responsibility. By providing incentives for plastic recycling, it encourages responsible waste disposal while promoting eco- friendly habits among users. With its scalable design, robust security features, and potential for future enhancements, Eco Vend serves as a practical and impactful tool in the fight against plastic pollution.

The integration of IoT-based hardware and software components ensures a seamless experience, making Eco Vend an ideal solution for deployment in public spaces. Future upgrades, such as AI-powered bottle recognition and expanded reward options, will further enhance the system's efficiency and adoption.

Acknowledgment

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