Smart Dustbin for Food Recognition for Waste

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Abstract:
In large events like weddings, itˆ as common to see guests leaving uneaten food on their plates. This leads to a lot of food waste, which is an ongoing concern for event organizers and environmental advocates. To tackle this issue, we are proposing a ”smart dustbin system” that helps reduce food waste by detecting significant food leftovers on plates before they are thrown away. Here as how it works The smart dustbin is equipped with a real-time camera and uses image processing technology to monitor the contents of plates as they approach the bin. When someone tries to dispose of their plate, the system scans it and evaluates whether there is a substantial amount of food left on it. If there is, the dustbin will temporarily stay closed, prompting the person to reconsider discarding that much food. This way, guests are encouraged to be more mindful about what they throw away, and event staff can also track the amount of leftover food more easily. By preventing food from being discarded irresponsibly, this smart dustbin helps reduce waste and promote more sustainable practices at large events.

Keywords: Smart Dustbin System, Food Waste Reduction, Event Sustainability, Image Processing Technology, Real-time Food Detection, Sustainable Event Planning, Leftover Food Detection, Eco-Friendly Events, Waste Management Solutions, Responsible Food Disposal, Sensor-based Waste Control, Environmental Awareness, Event Waste Tracking.

INTRODUCTION

This project aims to tackle food waste at large events by implementing an AI-powered smart dustbin system equipped with real-time camera technology and sensors. The system's primary function is to monitor the amount of food left on plates before it reaches the disposal stage. When a user approaches the bin, a camera captures an image of the plate and uses machine learning algorithms to analyze the quantity and type of food present.

If the system detects a significant amount of uneaten food, it prevents the bin from opening and displays a friendly reminder, encouraging guests to be mindful about wasting food. Guests are provided with options to either take the plate back to consume more or place the leftovers in a designated section for redistribution or composting, if available.

The bin’s functionality extends beyond individual awareness. It collects data on the volume and type of food waste generated, enabling event organizers to track waste patterns and gain insights into consumption habits. This data is invaluable for planning future events, allowing organizers to adjust food quantities, menu items, and serving sizes to better match attendees' preferences and reduce waste.

Additionally, the smart dustbin system can integrate with a mobile or web-based dashboard, giving organizers real-time access to waste metrics. The dashboard can generate detailed reports, including graphs showing peak waste times, most discarded food types, and overall event waste, facilitating data-driven decision-making.

LITERATURE SURVEY

Sr no	Title of paper	Author name	IEEE journals/conference
1	Smart Dustbin Management System Using IoT and Image Processing	M. D. Chavhan, V. N. Thakare	26th june 2021
2	Food Waste Management and Control System Using IoT and Image Processing	R. S. Gade, S. D. Bhide	22th April 2020
3	AI-Based Food Waste Detection System for Events and Gatherings	S. A. Sharma, M. T. Meena	12th December 2019
4	Smart Bin System for Sustainable Food Waste Management Using Computer Vision	J. Kim, H. Park	25th march 2022

METHODOLOGY

- Requirement Analysis and Feasibility Study: Identify and assess the feasibility of all system requirements to meet user and operational needs.
- System Design and Architecture: Develop a design and architecture that integrate hardware and software components for seamless operation.
- Image Processing and Machine Learning Model Development: Build and optimize a machine learning model to accurately detect food leftovers in real time.
- Hardware Integration and Prototyping: Assemble hardware components and create a prototype to test functionality and integration.
- Software Development: Develop the software for image processing, user interface, and data tracking for effective system performance.

OBJECTIVE

- Requirement Analysis and Feasibility Study: To thoroughly understand user requirements and assess the technical, economic, and operational feasibility to ensure project viability and alignment with user expectations.
- System Design and Architecture: To create a comprehensive and scalable design that integrates hardware and software components effectively, ensuring reliable performance and easy maintenance.
- Image Processing and Machine Learning Model Development: To develop an accurate and efficient image processing model that can detect significant food waste on plates in real time, optimizing for high accuracy and fast response times.
- Hardware Integration and Prototyping: To assemble and test all hardware components within a functional prototype, ensuring that each element (camera, sensors, locking mechanism) works cohesively as a system.
- Software Development: To develop software that accurately processes images, tracks data, and provides user prompts, ensuring ease of use and high functionality in waste management.
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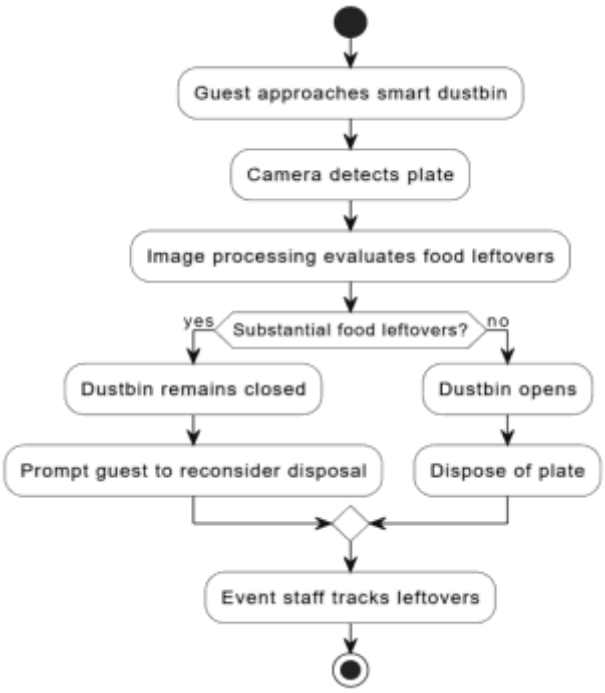
PROBLEM DEFINATIONS

At large events such as weddings, banquets, and corporate gatherings, food is often served in abundance to ensure guest satisfaction. However, this generosity frequently leads to excessive food waste, with large quantities of uneaten food left on guests' plates. This not only results in increased waste management costs for event organizers but also has severe environmental consequences. Food waste in landfills contributes significantly to methane emissions, a potent greenhouse gas, and squanders the water, energy, and resources used in food production and preparation.

Traditional waste disposal systems offer no way to measure or manage food waste effectively. They passively collect garbage without providing feedback or encouraging behavioural change. Event organizers, therefore, lack visibility into the scale and nature of food waste generated during events, making it difficult to implement targeted sustainability practices or improve menu planning.

To address these challenges, the development of a smart dustbin system presents a forward-thinking solution. This system leverages real-time image processing, computer vision, and machine learning algorithms to detect the quantity and type of food being discarded. When it identifies substantial food leftovers on a plate, it can trigger a gentle visual or audio prompt encouraging guests to reconsider their disposal or to serve themselves more mindfully in the future. This subtle nudging mechanism promotes awareness and responsible behaviour without being intrusive.

FLOW CHART



FUCTIONAL REQUIREMENTS

- The system must detect significant leftovers on plates using a real-time camera and image processing technology.
- If the system identifies a substantial amount of uneaten food on a plate, the dustbin should remain temporarily closed to prompt users to reconsider disposing of their food.
- The system should display a prompt or notification indicating that the user has significant leftovers, encouraging mindful disposal.
- The system must record and log the amount of food waste for each plate or session, providing event organizers with valuable insights.

- Generate reports on food waste trends and patterns for event organizers to help in future food quantity planning.
- Allow event staff or system administrators to override the locking mechanism when necessary (e.g., during clean-up or maintenance).
- The system should have an efficient power management module, allowing it to operate continuously throughout an event.

NON FUCTIONAL REQUIREMENTS

- The image processing technology should accurately distinguish between leftover food and an empty plate, achieving high accuracy in food detection.
- The system should detect and respond to each plate within a short time frame (ideally within 2 seconds) to prevent guest frustration.
- The system must be robust and operate reliably for extended periods to avoid disruptions during long events.
- The system should be scalable to support various bin sizes and multiple bins if needed at larger events.
- The interface for the notification or prompt should be user-friendly and understandable, guiding guests effectively.
- The smart dustbin should be built with durable materials to withstand usage in different event settings.
- The system should only capture images required for food detection and should not store images that could compromise guests' privacy.
- The system should consume minimal power to operate efficiently throughout events without frequent recharging or power interruptions.
- The system should require minimal maintenance, allowing for easy cleaning, troubleshooting, and parts replacement.

RESULTS

Fig(a): Top (Front side)

Fig(b): Side image

Fig(c): Top/Side view

CONCLUSION

In conclusion, the Pronunciation Checker system offers an innovative and comprehensive solution to the challenges faced by language learners in improving their speaking and pronunciation skills. By integrating advanced deep learning techniques with cutting-edge speech recognition technology, the system provides real-time, accurate, and personalized feedback on pronunciation, tailored to individual learning needs. It identifies specific mispronunciations, delivers precise phonetic corrections, and offers detailed explanations of word meanings, enabling users to understand and rectify their mistakes effectively. The system's ability to track user progress over time further enhances its value, fostering consistent improvement and ensuring learners remain motivated throughout their language learning journey. Its adaptability to various accents and dialects ensures inclusivity, providing relevant feedback to users from diverse linguistic backgrounds. The intuitive, user-friendly interface makes the tool accessible to users of all ages and technical proficiencies,

enhancing its usability and engagement. Furthermore, the comprehensive progress reports and feedback system enable learners to identify patterns in their pronunciation errors, allowing for targeted practice and improvement. The system's cross-platform functionality and secure data management make it a reliable and flexible tool that can be used on different devices and in various settings, catering to the needs of modern learners. Overall, the Pronunciation Checker system not only enhances language acquisition but also builds confidence in spoken communication, making it an invaluable resource for students, professionals, and anyone looking to improve their pronunciation and fluency in any language.

REFERENCES

1. Pitfalls of Machine Learning Methods in Smart Grids: A Legal Perspective, Gorge jems, clea decker , cloe, 2021
2. A Computing Engine for the New Generation of Learning Environments, Alfred joe, Taylor mirinda,, 2020
3. Developing a Virtual Smart Total Learning Environment for Future Teaching-Learning System, Allena , trexi shaen, 2020
4. Connecting formal and informal learning in Smart Learning Environments, Seemin niclors , rafal john , 2021
5. Pronunciation Scoring With Goodness of Pronunciation and Dynamic Time Warping, Kavita Sheoran; Arpit Bajgoti; Rishik Gupta; Nishtha Jatana; Geetika Dhand; Charu Gupta, 13 February 2023
6. Pronunciation Modeling With Reduced Confusion for Mandarin Chinese Using a Three-Stage Framework, Ming-Yi Tsai; Fu-Chiang Chou; Lin-Shan Lee, 22 January 2003
7. Supervised Detection and Unsupervised Discovery of Pronunciation Error Patterns for Computer-Assisted Language Learning , Yow-Bang Wang; Lin-shan Lee, 05 January 2015
8. Japanese Pronunciation Evaluation Based on DDNN, Deguo Mu; Wei Sun; Guoliang Xu; Wei Li 2 December 2020
9. Stochastic Pronunciation Modeling for Out-of-Vocabulary Spoken Term Detection
10. State-dependent phonetic tied mixtures with pronunciation modeling for spontaneous speech recognition , Yi Liu; P. Fung, 31 july 2004