e – Proceedings

IUGeT

Proceeding for International Undergraduates Get Together 2024 (IUGeT 2024)

"Undergraduates' Digital Engagement Towards Global Ingenuity"

2nd Edition

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"Undergraduates' Digital Engagement Towards Global Ingenuity"

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ECOPACK: THE RECYCLED AUTO-PACKING TRASH CAN

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Abstract
EcoPack: The Recycled Auto-Packing Trash Can address the growing environmental concern of waste management by introducing an innovative solution that optimises trash disposal. The increasing volume of waste, coupled with inefficient trash packing, exacerbates landfill overflows and environmental pollution. EcoPack aims to reduce waste volume and enhance recycling efficiency through an automated, eco-friendly trash can. Utilising a mechanism that compresses and packs trash into recyclable materials, EcoPack integrates sensors and smart technology to detect and sort different types of waste. The methodology involves the development of a prototype equipped with solar-powered compactors, IoT-enabled sensors, and an easy-to-use interface for consumers. Initial tests demonstrate significant reductions in waste volume and improvements in recycling rates. In short, EcoPack presents a sustainable solution to modern waste management challenges, promoting environmental conservation and resource efficiency. The project aims to revolutionise household waste disposal and contribute to broader efforts in reducing the global environmental footprint.

Keywords: *Waste management, automated trash can, eco-friendly*

1. INTRODUCTION

EcoPack: The Recycled Auto-Packing Trash Can is a pioneering initiative aimed at addressing critical waste management issues. The scope of EcoPack encompasses household and small business waste disposal, focusing on reducing the volume of trash that ends up in landfills and improving recycling efficiency. The core objective is to create a user-friendly, automated system that not only compacts and packs trash but also sorts recyclable materials effectively. The problem at hand is the increasing volume of waste and the inefficiencies in current waste disposal methods, which contribute to landfill overflows and environmental pollution. Traditional trash cans do not optimise space, leading to frequent disposal needs and poor recycling practices. EcoPack seeks to mitigate these issues by introducing a smart, sustainable solution that minimises waste volume and promotes better recycling habits, ultimately contributing to a cleaner and more sustainable environment.

The concept of automated waste management systems has gained traction in recent years, with several innovations aimed at enhancing efficiency and sustainability. Smart trash cans, such as the Bigbelly Solar, have demonstrated the effectiveness of solar-powered compactors in reducing waste volume and the frequency of waste collection trips. Studies on automated sorting systems, like those used in recycling plants, have significantly improved material recovery rates, highlighting the potential benefits of integrating such technology into household trash cans. Recent advancements in Internet of Things (IoT) technology have further enabled the development of intelligent waste management solutions. IoT-enabled sensors can detect different types of waste and optimise the sorting process, as evidenced by projects like Bin-E, which utilises AI to automatically sort waste into appropriate categories.

Additionally, research into consumer behaviour indicates that convenience and ease of use are critical factors in encouraging proper recycling practices. EcoPack builds upon these innovations by combining solar-powered compacting, IoT-enabled sorting, and user-friendly design to address both the environmental and practical challenges of waste management. By leveraging existing technologies and addressing gaps identified in previous studies, EcoPack aims to provide a comprehensive solution that reduces waste volume, enhances recycling efficiency, and promotes sustainable habits.

2. MATERIALS AND METHODS

2.1 Materials

Materials used for EcoPack:

i. Structural Components:
- Recycled Plastic: For the main body to ensure durability and sustainability.
- Stainless Steel: For the internal compartments and the compaction unit to provide strength and longevity.
- Tempered Glass: For covering the solar panels to protect them from environmental damage.

ii. Electronic Components:
- Solar Panels: Provide renewable energy to power the device.
- IoT-enabled Microcontroller: Manages data from sensors and controls the mechanical operations.
- Sensors: Proximity sensors to detect waste, weight sensors to measure fill levels, and an AI module for waste classification.

iii. Mechanical Components:
- Electric Motor and Hydraulic System: Drive the compaction mechanism to reduce the volume of waste.
- Conveyor Belts and Sorting Bins: Facilitate automated waste segregation based on its type.

iv. Software:
- IoT Platform: Enables remote monitoring and data analysis.
- Mobile Application: Provides a user interface for real-time updates and control.
- Algorithms: Classify waste types to improve sorting efficiency.

2.2 Methods

Methods for using the EcoPack:

i. Design and Assembly:
- Prototype Development: Created using CAD software, focusing on an ergonomic and compact design.
- Solar Panel Integration: Solar panels are installed on the lid and connected to a battery system to ensure continuous operation.

ii. Sensor and IoT Integration:
- Sensor Placement: Proximity and weight sensors are strategically placed to maximise accuracy.
- Microcontroller Configuration: The microcontroller collects data from sensors and communicates with the mobile app.

iii. Compaction Mechanism:
- Installation: An electric motor coupled with a hydraulic press is installed for waste compaction.
- Calibration: The system is tested to calibrate pressure for optimal compaction without damaging internal components.

iv. Automated Sorting:
- AI Training: AI algorithms are trained using labelled datasets to recognise different waste types.
- Sorting Mechanism: Conveyor belts transport waste to sorting bins, guided by the AI module.

v. User Interface Development:
- Mobile App Development: An app is created to provide real-time data on waste levels, compaction status, and sorting efficiency.
- User Testing: Feedback from user testing is used to refine the app's functionality and usability.

vi. Testing and Optimisation:
- Prototype Deployment: Tested in various environments to monitor performance metrics such as waste reduction, sorting accuracy, and energy consumption.
- Data Analysis: Collected data is analysed to identify areas for improvement, leading to optimisation of both hardware and software components.
- These methods ensure that EcoPack is an effective and user-friendly solution for modern waste management challenges, promoting environmental sustainability and operational efficiency.

3. RESULTS AND DISCUSSION

EcoPack represents a breakthrough in waste management, offering an innovative trash can system that seamlessly integrates advanced automation with the use of recycled and biodegradable materials. This cutting-edge system not only streamlines waste disposal processes, significantly boosting efficiency, but also aligns with global sustainability goals by actively reducing waste and minimising carbon footprints. EcoPack's commitment to using environmentally responsible materials makes it the ideal choice for companies striving to meet and exceed international sustainability standards. By choosing EcoPack, businesses can enhance their environmental impact while optimising their operational efficiency. The demand for sustainable EcoPack trash can solutions is driven by growing environmental concerns and increasing regulatory pressures. Traditional waste management methods often result in excessive waste and environmental harm, making it essential to find alternatives that are both efficient and eco-friendly. EcoPack addresses these challenges by utilizing recycled materials and automating the waste disposal process, thereby reducing waste and enhancing sustainability. EcoPack represents the future of waste management. By adopting the EcoPack system, companies can not only improve their operational efficiency but also contribute to a healthier planet. Embrace EcoPack and join the eco-friendly revolution in sustainable waste management.
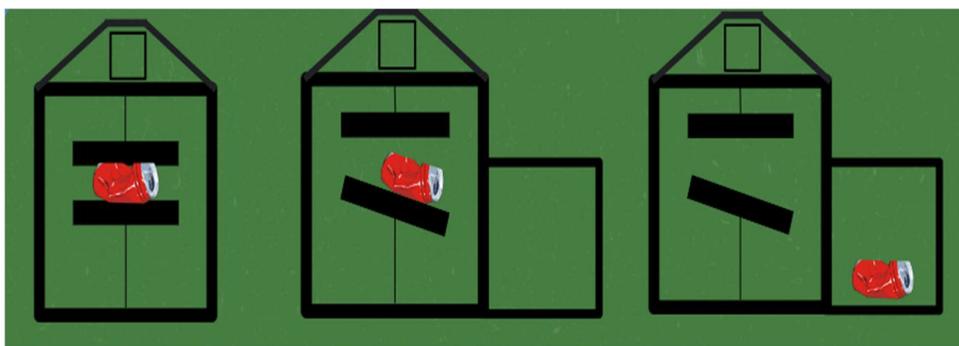

Figure 1: Example of Ecopack Use on Canvas.

4. CONCLUSION

EcoPack represents a significant advancement in the waste management industry by merging cutting-edge automation technology with a strong commitment to sustainability. As businesses face increasing pressure to reduce their environmental impact and improve operational efficiency, EcoPack offers a solution that effectively meets both needs. By utilising recycled and biodegradable materials, EcoPack reduces reliance on virgin resources and minimises waste, contributing to a more sustainable, circular economy. Its customisable capabilities ensure that products are securely and efficiently managed, enhancing productivity and reducing labour costs. The seamless integration with existing production lines and inventory systems further streamlines operations, allowing businesses to transition smoothly to this advanced waste management solution.

EcoPack not only aligns with current regulatory standards for sustainable practices but also positions companies as leaders in environmental responsibility. This can enhance brand image and customer loyalty, as consumers increasingly prefer products and companies that prioritise sustainability. Additionally, early adoption of EcoPack provides a competitive advantage by differentiating businesses in the market and appealing to eco-conscious consumers. In summary, EcoPack is a forward-thinking waste management solution that addresses the critical need for sustainability while improving operational efficiency. It is an ideal choice for companies looking to enhance their waste management processes, reduce environmental impact, and stay ahead in an increasingly eco-conscious market.

5. ACKNOWLEDGEMENT

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Sekian, terima kasih.

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