

Smart Bin

"An AI-powered waste sorting assistant that accurately identifies trash types and auto sorts into bins, with real-time educational display for effortless recycling."



Background

With the acceleration of urbanization in our country, the annual production of municipal solid waste has exceeded 200 million tons. The traditional manual sorting method faces three core pain points: low sorting accuracy (only 65%), high labor costs, and insufficient public participation. According to statistics from the Ministry of Housing and Urban-Rural Development, incorrect sorting results in a contamination rate of recyclable materials as high as 40%, which severely restricts the progress of building a 'waste-free city'.



Design Background



Facing low efficiency (<65% accuracy) in manual waste sorting, SmartBin utilizes OpenMV vision recognition (92%+ accuracy) and servo-driven auto-sorting (0.5s response) to boost recycling rates by 40%. The interactive display provides real-time guidance, making waste classification effortless and sustainable.



政府信息公开

| | | |
|---|----------------------|---------------|
| 公开事项名称: 关于印发《“十四五”城镇生活垃圾分类和处理设施发展规划》的通知(发改环资〔2021〕642号) | | |
| 索引号: | 000013039-2021-00210 | 主办单位: 国家发展改革委 |
| 制发日期: | 2021-05-06 | |

国家发展改革委 住房城乡建设部关于印发 《“十四五”城镇生活垃圾分类和 处理设施发展规划》的通知

发改环资〔2021〕642号

各省、自治区、直辖市及计划单列市、新疆生产建设兵团发展改革委,各省、自治区住房城乡建设厅,北京市城市管理委,天津市市容园林委,上海市绿化市容局、重庆市市政委,计划单列市城市管理局(市政公用局、城市建设局、市政园林局):

为深入贯彻落实习近平总书记关于生活垃圾分类的重要批示指示精神,落实党中央、国务院决策部署要求,统筹推进“十四五”城镇生活垃圾分类和处理设施建设工作,加快建立分类投放、分类收集、分类运输、分类处理的生活垃圾处理系统,国家发展改革委、住房城乡建设部组织编制了《“十四五”城镇生活垃圾分类和处理设施发展规划》,现印发你们,请遵照执行。

国家发展改革委
住房城乡建设部
2021年5月6日

附件名称

图 《“十四五”城镇生活垃圾分类和处理设施发展规划》

National-level policy support

"14th Five-Year Plan for the Development of Urban Household Waste Classification and Treatment Facilities"

★ Clearly require comprehensive promotion of household waste separation, expand kitchen waste processing capacity, advance the construction of incineration treatment facilities, and improve the utilization rate of waste resources.

★ Establish special funds to support the research and development of waste treatment technology and demonstration projects, and encourage the application of intelligent sorting systems.

Survey questionnaire Investigation Summary

一、基础信息

1. 您所在的社区是否已实施垃圾分类？
☐ 是（已实施____年） ☐ 否 ☐ 试点中
2. 您日常处理垃圾的主要痛点是？（多选）
☐ 分类规则复杂 ☐ 时间成本高 ☐ 垃圾桶分布不便
☐ 不清楚具体分类标准 ☐ 其他_____

二、技术功能验证

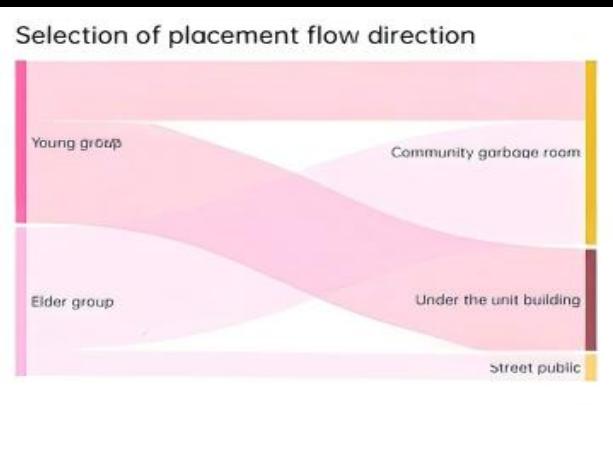
3. 您认为智能分类最需改进的环节是？
☐ 识别准确性 ☐ 分拣速度 ☐ 操作便捷性 ☐ 维护成本
4. 对以下功能的接受度评分（1-5分）：

| 功能 | 1分(不需要) → 5分(非常需要) |
|---------|--|
| 自动开盖 | <input type="checkbox"/> 1 <input type="checkbox"/> 2 <input type="checkbox"/> 3 <input type="checkbox"/> 4 <input type="checkbox"/> 5 |
| 语音分类指导 | <input type="checkbox"/> 1 <input type="checkbox"/> 2 <input type="checkbox"/> 3 <input type="checkbox"/> 4 <input type="checkbox"/> 5 |
| 满溢报警 | <input type="checkbox"/> 1 <input type="checkbox"/> 2 <input type="checkbox"/> 3 <input type="checkbox"/> 4 <input type="checkbox"/> 5 |
| 碳积分奖励系统 | <input type="checkbox"/> 1 <input type="checkbox"/> 2 <input type="checkbox"/> 3 <input type="checkbox"/> 4 <input type="checkbox"/> 5 |

“This survey collects user feedback on usage scenarios, functional needs, and improvement priorities of the system.”

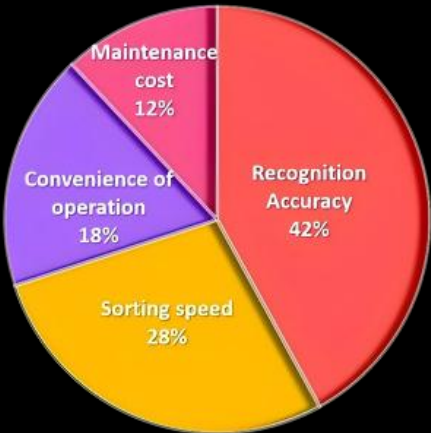
| Function Acceptance Heatmap | | | | | | |
|-------------------------------|---------|---------|---------|---------|---------|---------|
| Function | 1 point | 2 point | 3 point | 4 point | 5 point | Average |
| Automatic lid opening | 5% | 12% | 23% | 35% | 25% | 3.63 |
| Voice classification guidance | 8% | 15% | 30% | 28% | 19% | 3.35 |
| Overflow alarm | 3% | 7% | 18% | 40% | 32% | 3.91 |

“The survey results reveal clear user priorities, providing practical guidance for feature selection and system optimization.”



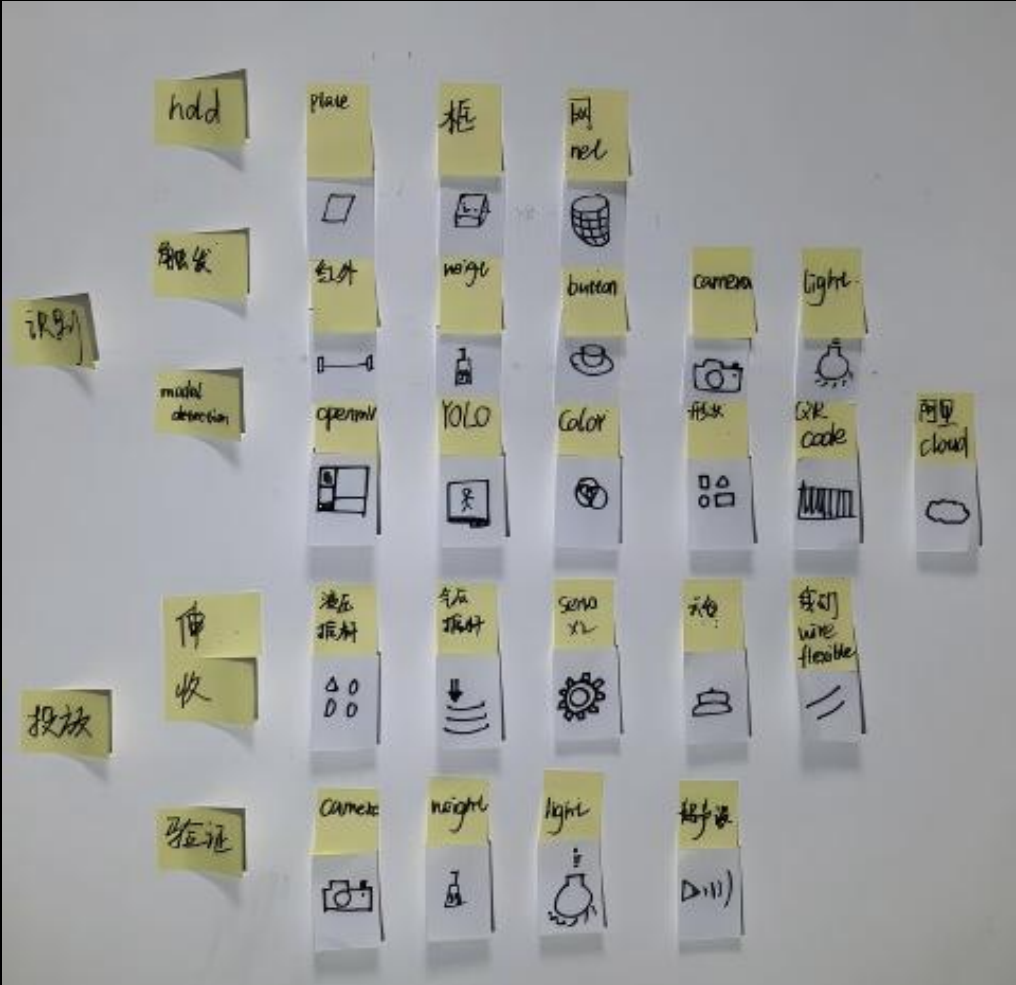
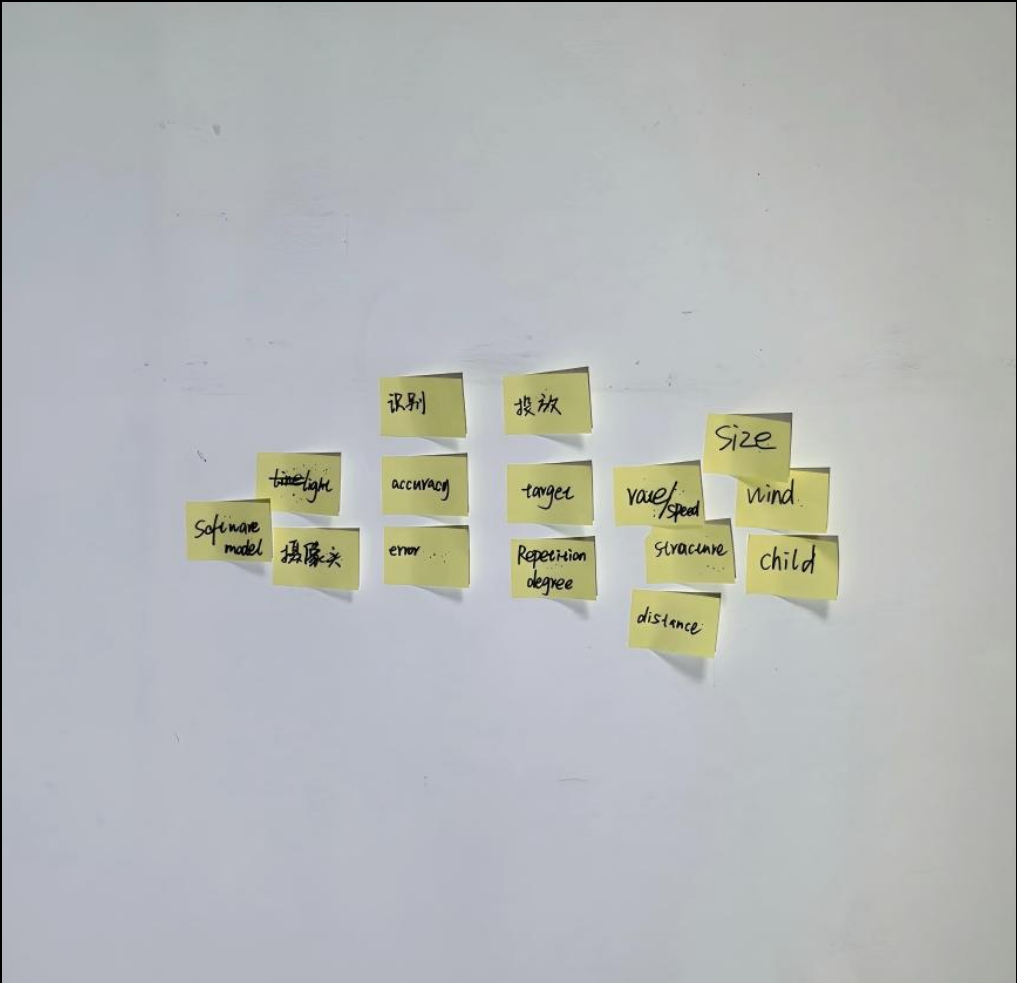
“The findings suggest that placement strategies should be tailored to different user groups.”

Distribution of the most needed improvement areas

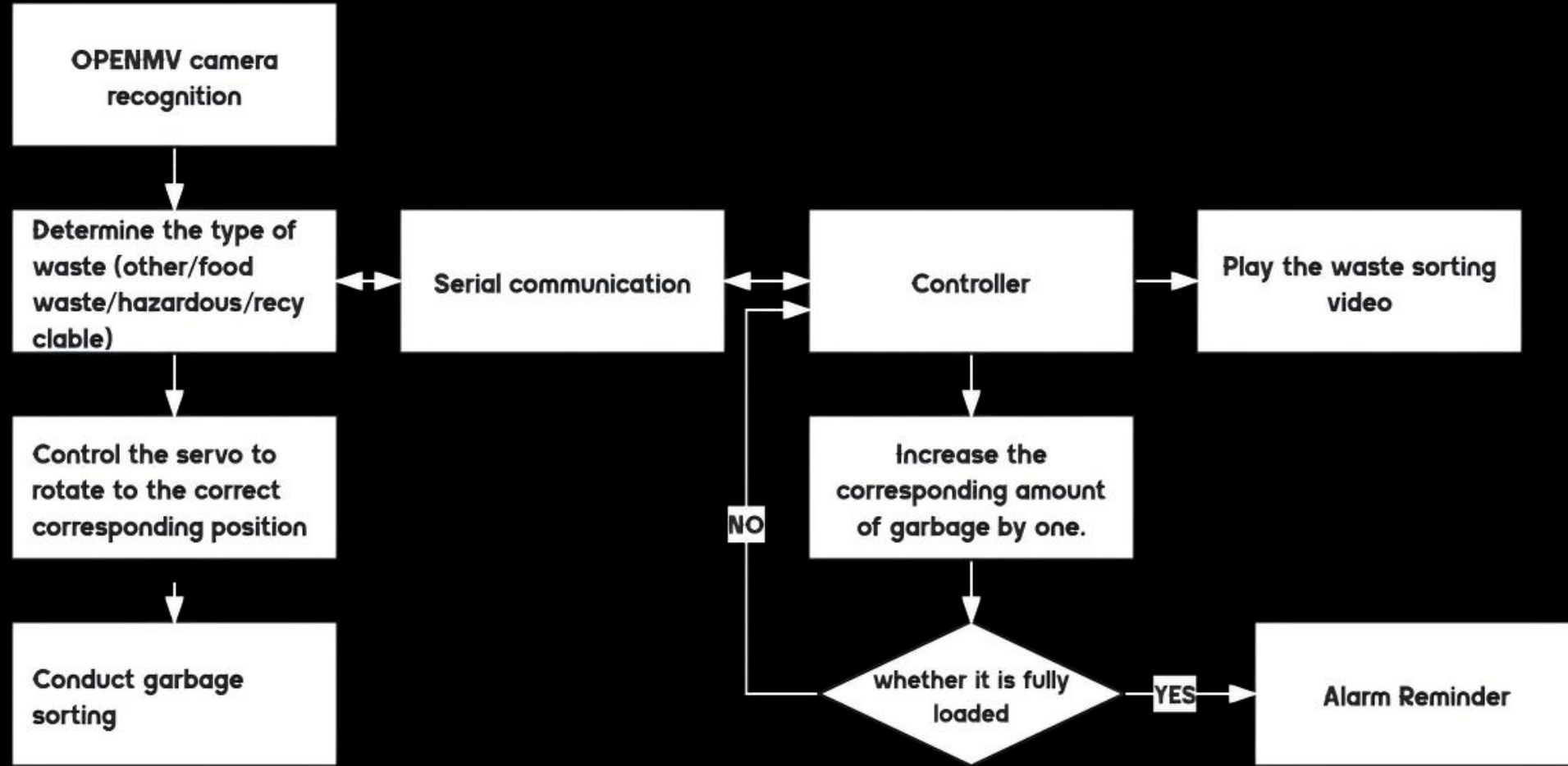


“Survey data indicate that recognition accuracy and operational efficiency are the most critical areas requiring improvement.”

Brain Strom



Product Flow Diagram



Rapid Prototype



The initial prototype features a cross-shaped arrangement of four bins, with the load-bearing platform positioned at the center. This layout allows the OpenMV system to easily identify the orientation (forward, backward, left, or right) for precise waste disposal into the corresponding bin.

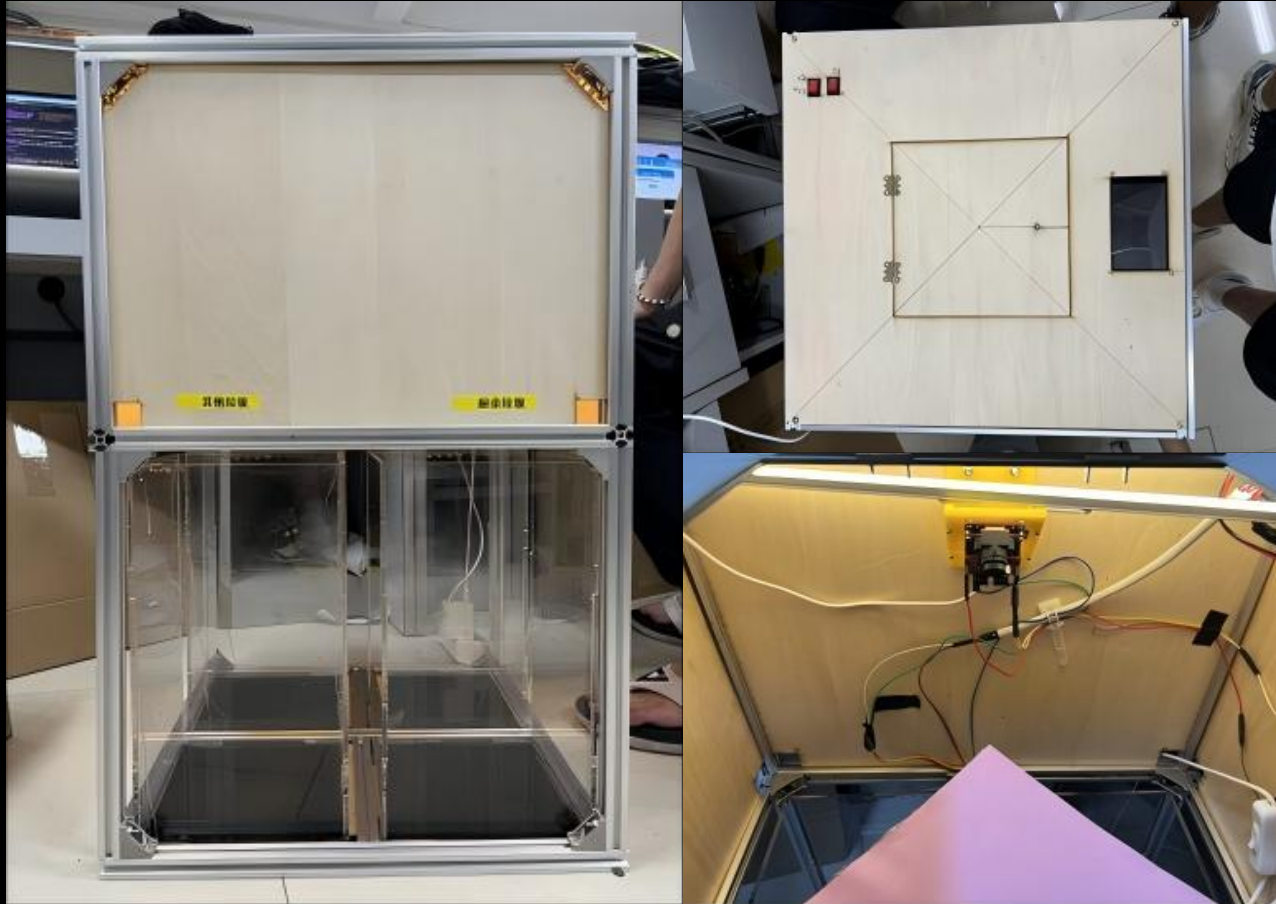


The four bins are arranged in a linear layout, with the concept of using a tracked system combined with a servo for waste placement. After the OpenMV system identifies the waste on the load-bearing platform, the tracks move the platform to the target bin while the servo executes precise rotation.



The final design features a square-grid (田-shaped) arrangement, with the load-bearing platform located at the cross intersection and rotated 45°. Each corner of the platform aligns with the edge of a bin, and the recessed center reduces material usage. This configuration is structurally simple, stable, and ensures even load distribution for efficient waste disposal.

Exterior Design (Initial edition)



Main Function

- ★ Classification and identification: Accurately identify waste types through the camera (accuracy rate of 92.3%), supporting different categories such as recyclables and kitchen waste.
- ★ Automatic sorting: Servo-supported platform for fast sorting, replacing manual placement.
- ★ Conduct knowledge dissemination: The LCD screen provides a video on the screen about correct waste classification to help people learn how to properly sort their household garbage.
- ★ Intelligent Management: Overflow alarm, ultrasonic sensors monitor the barrel content level, trigger alarms and send cleaning requests.

Story Board



★ Picture 1: Every day, more than 60% of the waste is incorrectly classified.

★ Picture 2: Recyclable materials are polluted, harmful waste is mixed in, and the problem is serious!

★ Picture 3: AI automatic classification, goodbye to confusion!

★ Picture 4: Recognize in 1 second, automatic sorting!

★ Picture 5: Help residents understand how to sort garbage.

★ Picture 6: Change is happening from individuals to communities.

Personal & Team Working

- ★ Market & Demand: Surveyed waste classification issues (low accuracy, lack of awareness), proposed smart bin concept with AI recognition, auto-sorting, and educational features.
- ★ Product Design: Worked with the team to optimize OpenMV-based AI recognition (>90% accuracy) and integrate sensors/actuators for seamless operation.
- ★ Mechanical Design: CAD-designed 4-bin layout with servo mechanism for precise sorting. Acrylic housing via laser-cut assembly.
- ★ Agile Development: Led goal-setting, progress tracking, and obstacle resolution; shared CAD, circuits, and test reports via online tools for transparency