Poomba!

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Configuration

Chassis:
- C-Channels used for main body
- Vex motors are installed on each wheel (4)
- Steel and aluminum plates are placed on chassis for storage and hardware components
- Omni wheels for easier mobility to move forward and turn with minimal friction
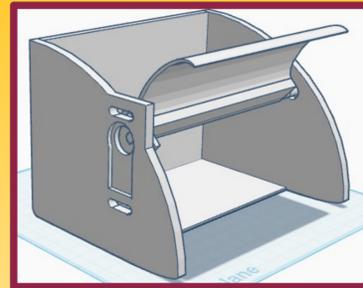
Scooper:
- 3-D printed scooper used to collect waste
- Attached to a C-channel on the opposite end of a mounted MG996R servo motor
- Second servo mounted on scooper, functioning as a rake for optimal collection

Sensors:
- HC-SR04 Ultrasonic – Measures distance using sound waves; stops the robot if an obstacle is within 1 ft.
- TCS3200 Color Sensor – Detects surface color beneath robot; allows movement only when green is detected.
- Integration: Both sensors guide safe navigation by controlling when to stop, turn, or move forward.
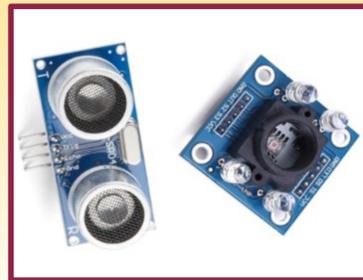
Intro

- Poomba is an autonomous robot that uses AI and computer vision to find, approach, and scoop dog waste.
- It navigates lawns and avoids obstacles while cleaning outdoor areas.
- The goal is to provide a hands-free, efficient way to keep parks and public spaces cleaner.
- Poomba helps reduce sanitation issues caused by unattended pet waste.
- It offers a reliable solution for pet owners, park staff, and city workers who maintain outdoor spaces.

Object Detection

Hardware Components:
- Raspberry Pi 5 – runs the inference model and controls motors
- Raspberry Pi Camera Module – captures real-time video for detection
- On-device model trained and exported from Edge Impulse


Object Detection Pipeline:
- Live camera feed is processed on the Raspberry Pi
- Frames are sent to a trained Edge Impulse FOMO model
- The model identifies "waste" object class with bounding boxes
- Only detections above a set confidence threshold are acted on
- Output coordinates guide the robot's movement toward the target

Edge Impulse Model Training:
- Collected dataset of pet waste images
- Performed data augmentation (lighting, angle changes)
- Trained using Edge Impulse's FOMO architecture
- Validated accuracy before deployment
- Exported to the Raspberry Pi as a Linux Python SDK bundle
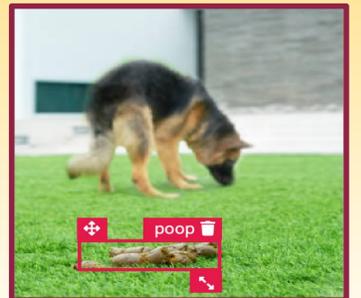
Wiring
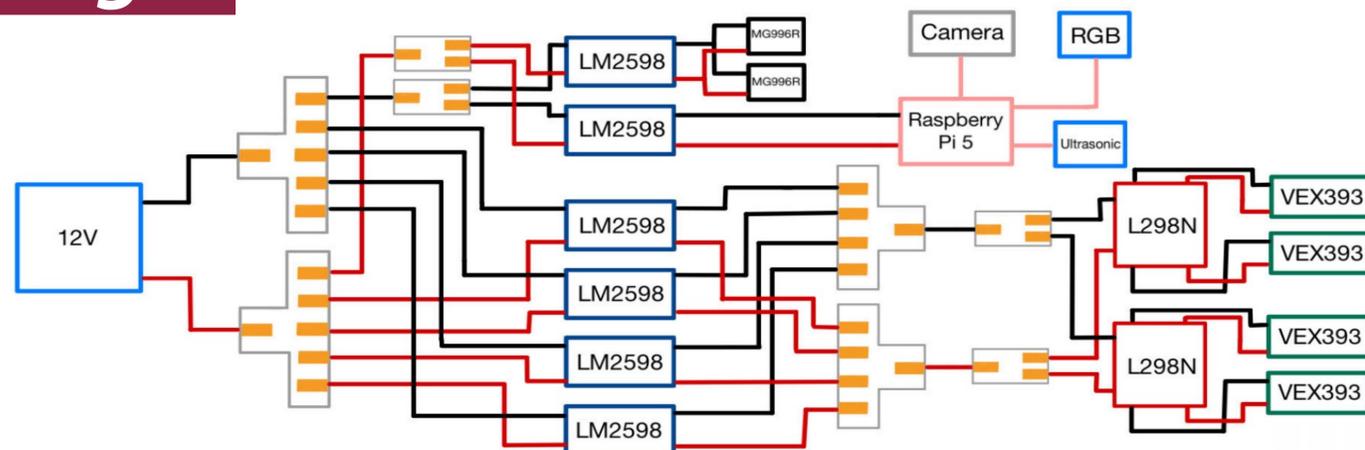
Impact

- ***Management*** – The team learned how to manage project costs and design an affordable system.
- ***Environmental*** – Impact was considered by reducing bacteria spread and keeping outdoor areas cleaner.
- ***Sustainability*** – Poomba reduces manual cleanup and uses a reusable, washable waste compartment.
- ***Safety*** – Prioritized by reducing human contact with harmful pathogens and designing safe navigation.

Conclusion

- Poomba provides an effective, AI-driven way to detect and collect dog waste in outdoor spaces.
- The team made strong progress on the detection system, chassis build, and scooping mechanism.
- The project shows benefits in cleanliness, cost savings, and sustainability.