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Title

WALTER - Wireless Autonomous Litter Transportation Earth Robot

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Authors

Hsu, Brandon
Nguyen, Tommy
Pham, Jeffrey
et al.

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W.A.L.T.E.R.
Wireless Autonomous Litter Transportation Earth Robot

Project Members: Brandon Hsu | Tommy Nguyen | Jeffrey Pham | Justin Lee
Engineering Faculty Mentor: Prof. Rainer Doemer (Dept. of EECS)

UROP

UCI Samueli School of Engineering | Department of Electrical Engineering and Computer Science

DEAN'S CHOICE AWARD

Background

In 2017, the United States produced approximately **267.8 million tons of waste**, equating to about 4.51 pounds of trash by the average American everyday [1]. Additionally, **91% of all plastics in the world are not recycled** and end up as waste [2]. Waste mismanagement is a serious and growing issue that negatively impacts the earth's climate, wildlife and the public health [1].

Objective

To mitigate this outcome, we propose a **trash collecting robot** named **WALTER**, who will collect consumer waste products such as soda cans, bottles, chip bags, containers, etc., **without human supervision**, to help our environment stay clean.

Research and Development

Perception: Vision-based deep learning trash detection model (YOLO) [3] paired with stereo camera disparity (depth) mapping.
Planning: Depth perception and trash detection are used for determining actions to take, e.g. move, rotate, stop, collect, etc.
Trash collection: WALTER detects trash, stops, lowers its ramp, extends its arms, and scoops trash up its ramp into its enclosure.

References

[1] Environmental Protection Agency. *National Overview: Facts and Figures on Materials, Wastes and Recycling*. Accessed on: Nov. 9, 2020. [Online]. Available: https://www.epa.gov/facts-and-figures-about-materials-waste-and-recycling/national-overview-facts-and-figures-materials

[2] L.Parker. *A Whopping 91 Percent of Plastic Isn't Recycled*. Accessed on: Nov. 10, 2020. [Online]. Available: https://www.nationalgeographic.org/article/whopping-91-percent-plastic-isnt-recycled/

[3] A. Bochkovskiy, C.-Y. Wang, and H.-Y. M. Liao, "YOLOv4: Optimal Speed and Accuracy of Object Detection," 2020.

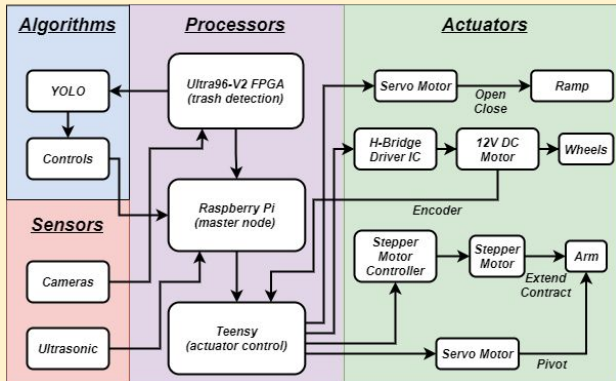## Cyber-Physical System Design

Fig. 1. High level system diagram of WALTER.

Fig. 2. CAD of WALTER (Left) and physical prototype of WALTER (Right). WALTER is assembled with 3D printed components.
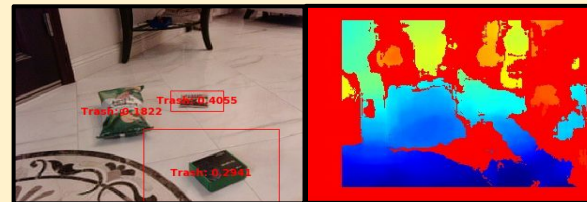
Experimental Results

Fig. 3. Example outputs of trash detection with depth estimation from stereo cameras.

Fig. 4. Example outputs of trash detection for indoor and outdoor environments (borders represent distinct frames).

Future Improvements

- Gathering more data
- Detecting multiple trash types
- Adding localization and mapping
- Refining trash detection model
- Installing more robust wheels
- Improving degs. of freedom
- Improving operational ability
- Hands and opposable thumbs