ROBOT SYSTEM FOR AUTONOMOUS CONSTRUCTION USING FOUND IRREGULAR OBJECTS

*"Our research aims to build a non-specialized **end-to-end** robotic system that **autonomously plans** and **executes** the **assembly** of **found irregular objects** to build a given target structure."*

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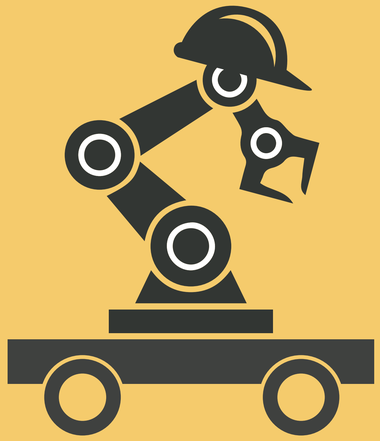
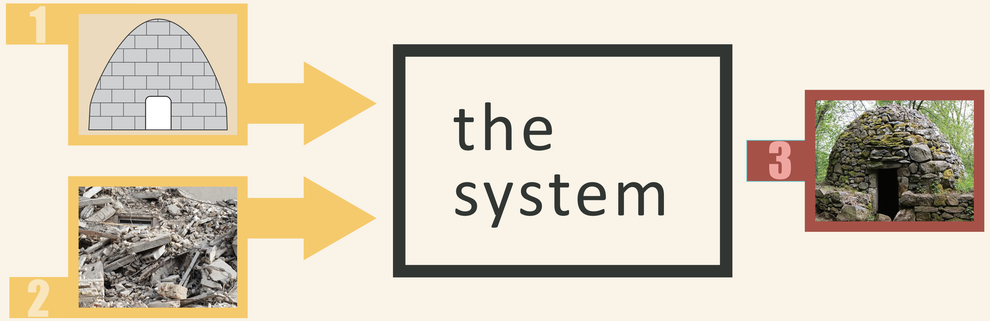


MOTIVATION

In scenarios that lack modern construction infrastructure, building with found on-site objects may be the only process available. For example, in remote environments such as extraterrestrial construction where the cost of transport is limiting, or in disaster areas where temporary structures need to be built quickly and possibly without a functioning supply infrastructure.

The ultimate problem we want to tackle is the scenario with a mobile arm that searches for irregular, found objects in an unstructured environment and builds a structure based on a given plan. Our present work concentrates on the design, construction and operation of the mobile arm that is able to scavenge for building materials, pick up and construct a target structure based on the steps of a planning algorithm.

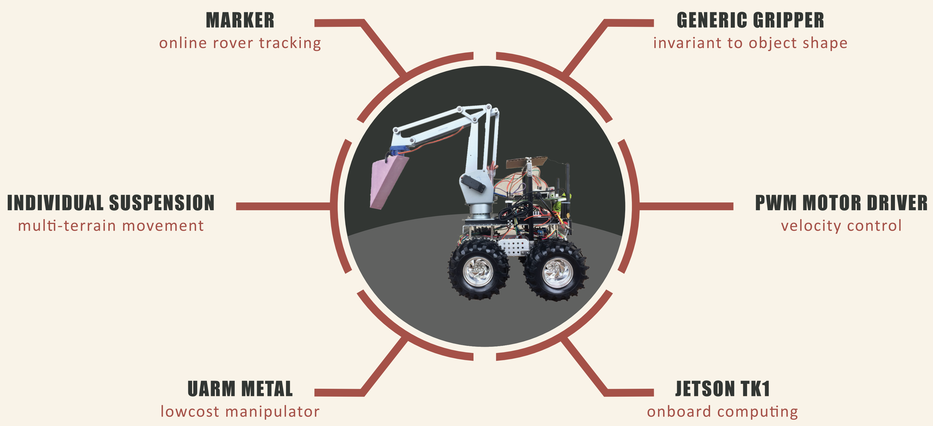


1 building plan

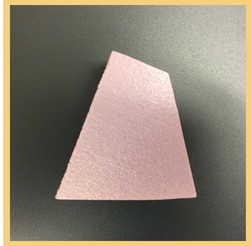
2 found objects at disaster areas

3 built structure

ROBOT DESIGN

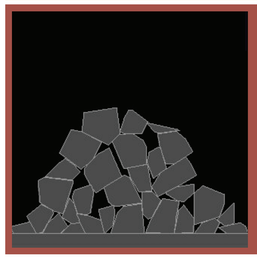


SYSTEM MODULES



perception

- External Kinect Sensor
- Offline 2D scanning of blocks for planning and online 2D scanning for state estimation
- Real-time tracking of rover pose
- Visual servoing for manipulation



assembly planning

- Assembly steps based on our assembly algorithm, given the target structure, current structure state and the available blocks

control

rover

- Dynamic Window Appraoch for real-time trajectory generation
- ILQR for trajectory optimization

arm

- Feedback control - LQR
- Visual Servoing

WORK IN PROGRESS

- Using Gaussian Process to learn the rover dynamics for different terrains
- A "generic" gripper that is virtually independent to the shape of the object
- On-board camera interfacing for visual servoing

CONCLUSION AND FUTURE WORK

We are developing a proof-of-concept design for a system that autonomously navigates in uneven terrains and builds dry stacked structures using found objects. Presently, we have **a rudimentary end-to-end system that picks up and places compliant bags**. However, we need a more fine-tuned rover planner that can suit varied terrains and an improved, online feedback manipulation control for the arm to pick up irregular objects at various poses.

REFERENCE

[1] Furrer, Fadri, et al. "Autonomous Robotic Stone Stacking with Online next Best Object Target Pose Planning." (2017).
[2] Soleymani, Touraj, et al. "Bio-inspired construction with mobile robots and compliant pockets." Robotics and Autonomous Systems 74 (2015): 340-350.Li, Weiwei, and Emanuel
[3]Lambert, Malcolm, and Paul Kennedy. "Using Artificial Intelligence to Build with Unprocessed Rock." Key Engineering Materials. Vol. 517. Trans Tech Publications, 2012.