ZenArt

Robot Autonomy Project Proposal

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Overview

For artists, the traditional art of Zen can be a source of inspiration and tranquility. This project aims to bring the essence of Zen art to life by designing and developing a robot that can create unique and beautiful Zen art pieces on a Buddha board.

Forward Process

The design of the robot includes a water brush attached rigidly to its end-effector, allowing for precise and controlled movements while creating Zen art pieces. Before the robot begins creating art, it will undergo a calibration process to ensure optimal performance. During this process, an overhead camera will automatically determine the location of the drawing surface (Buddha board) and the bowl of water. This detection will either be carried out using computer vision-based feature extraction techniques or using markers placed on the board.

Upon completion of calibration, the robot will receive an input image from which it will use algorithms to plan a series of strokes to imitate the given image as closely as possible, with as few strokes as possible.

Reset Process

We chose the Buddha board as our drawing surface primarily because the reset process is straightforward. The Buddha board is designed to automatically erase itself over a given duration (~5 min) as the water evaporates and the board dries out. Hence, the reset process will simply be to wait and allow the board to dry out.

Motion Generation Problem

There are two motion generation components in this problem: a) Generation of each brush stroke and b) Path planning for robot movement.

Stroke Generation: The brush strokes are generated from a given input image. To closely match the drawing to the image, we plan on experimenting with genetic algorithms (GitHub - genetic-lisa) to fit a series of strokes on the image. We will also experiment with the timing and order of each brush stroke, as the board may start drying out before the art is complete.

Path planning: Path planning for stroke execution will depend on the location of the board and the actual stroke to be executed.

Variability in the Problem

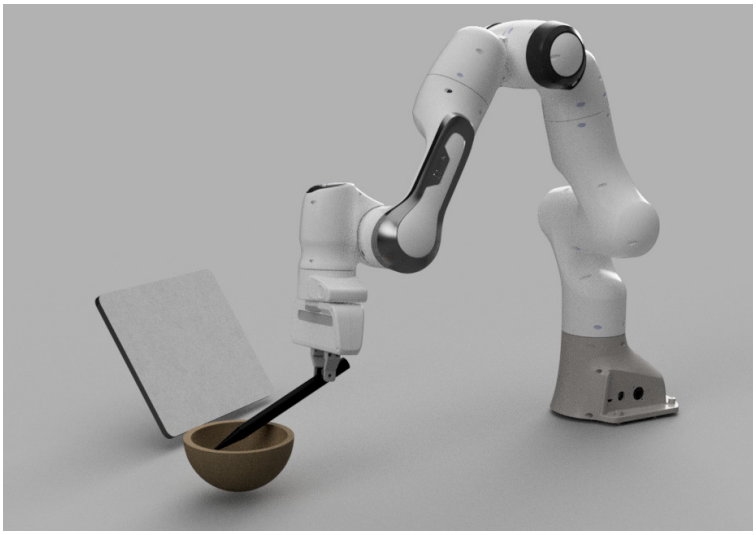
In this project, we will use an image input by a human to be drawn by the robot. Since the image itself is not unique and can be changed, there will be a significant variation in the drawing created by the robot. Further, if time permits, we also plan on experimenting with varying brush pressure to imitate more complex strokes (such as calligraphy).

Learning for Autonomy

The input image is the starting point for the robot to create a unique Zen art piece. The robot will use this image to determine the trajectory of the brush strokes, ensuring that the final product accurately captures the essence of the input image. This process can be a learnable algorithm.

Hardware Setup

1. A 3D printed attachment to couple the brush with the end effector
2. Buddha board.
3. A bowl of water to use for painting.



Extra Items Needed

We will require the following items to be purchased for executing our project.

1. Buddha board
2. Water bowl (can be any standard bowl - could also be borrowed). This often comes included with a Buddha board.

Shared Robot

The robot will be shared with the team working on Robot writing. Their team comprises Dhanesh Pamnani, Alec Trela, and Madhu Korada.

References

[1] Schaldenbrand, P., McCann, J., & Oh, J. (2022). FRIDA: A Collaborative Robot Painter with a Differentiable, Real2Sim2Real Planning Environment. *arXiv preprint arXiv:2210.00664*.