ECSE211 – Client Needs

Final Project Description for Students

Background

Creating visual art can be therapeutic and deliver many positive effects on the artist. However, visual art can be challenging to create for those who have motor impairments (e.g., individuals with Parkinson's disease, cerebral palsy, or a spinal cord injury). Tremor in the hands, loss of control of the fingers, or lack of mobility in the arms can make manipulation of paints and paint brushes near impossible.

Your client – a large robotics company – is interested in making art accessible for those with motor impairments. They believe that robots that manipulate cubes can allow people with physical disabilities to produce visual art in the form of a mosaic (see Figure 1 for an example).

Problem statement

The executives at the client company want to see a prototype of a mosaic robot. The protype should be able to take a user's input – which will indicate the image they would like to create – and use it to produce a mosaic of the image using a set of foam cubes.

The client's main priorities are accuracy, speed, and ease of use for the user. They envision the system to be operated safely by a single artist who have limited capacity to manipulate items with their hands/fingers. That is, the target users are able to press on buttons to provide input and dump a bag of cubes onto the system, but should not be expected to pick up or place individual cubes with precision.

The input image will be provided as an array of 1s and 0s, where 1 indicates that a cube should be placed, and 0 indicates that a cube should not be place in the location. For instance, for a 5x5 canvas, the input [0 0 1 0 0 0 1 0 1 0 1 0 0 0 1 0 1 0 1 0 0 0 1 0 0] should produce the image in Figure 2, and the input [1 1 1 1 1 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 1 1 1 1 1] should produce the image in Figure 3 using cubes. In both Figures 2 and 3, black square indicates where a cube of any colour should be placed, where as all the white background can be left empty.
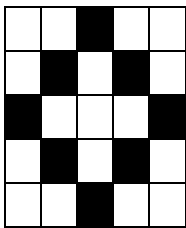

Figure 2. Mosaic image from the user input: [0 0 1 0 0 0 1 0 1 0 1 0 0 0 1 0 1 0 1 0 0 0 1 0 0]
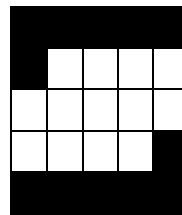

Figure 3. Mosaic image from the user input: [1 1 1 1 1 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 1 1 1 1 1]

Requirements

- The entire system must be able to hold 15 foam cubes of any colour provided by the client.
- The user should be able to provide their image input (i.e., an array of 0s and 1s) using two different methods: a) manually entering 0s and 1s using the keyboard for technicians to test the system, and b) button presses or other simple means of providing binary input.
- All foam cubes are to be loaded into the system before the robot starts to produce the mosaic. That is, once the robot starts to place cubes onto the canvas, users should not be requested to load more cubes onto the system.
- Once the system is loaded with the cubes and ready to draw the image onto the canvas, the system should communicate this to the user. Afterwards, the system can start drawing

automatically, or the user may be instructed to press a button or interface with the system in a simple way to start/trigger cube placing.

- The final image should be contained within a fixed 5x5 resolution canvas, where each pixel is 4.0 cm x 4.0 cm.
- The team should bring their own canvas with grid lines clearly outlining each of the 5x5 pixels. The canvas can be a fixed part of the system or placed on a flat surface with respect to the system.
- The system should finish the mosaic of any image input within 3 minutes.
- If the user provides an image requiring more cubes than the system has been loaded with, the system should communicate it to the user as an error.

Client Specifications

- The cubes should always be placed within the boundaries of the pixel.
- The size of the entire system must be < 1 m in all three dimensions.

Material and Budget

At the start of the project, each team will be distributed 20 foam cubes. The client budgeted 0$ to cover the cost of material. The teams are expected to deliver a solution using the two LEGO + BrickPi kits available to them. Teams can choose to use additional material (e.g., tape, paper, etc.). However, as start-ups, the cost associated with the material will imply that the team is operating at a loss for the project; therefore, spending large expenses are not encouraged. Same goes for any additional hours spent toward the project above the budget outlined in the Design Week Information document.

The material provided by the university are expected to be returned in its original condition. Therefore, students should not make permanent modification to any part of the DPM kit provided to them.

Evaluating success

Teams will demonstrate the performance of their final design to the client and other students on the Final Demo Day. In addition to the requirements listed above, the client will consider factors such as the speed of mosaic completion, ease of use, and accuracy of the final mosaic to evaluate the overall quality of the team's designs.