Artaic Enterprise Solution

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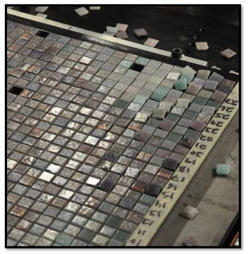
Artaic Innovative Mosaic

Artaic Innovative Mosaic is a mosaic assembly and design company that is separated from their competition by their use of industrial robotics to assemble custom mosaics on the fly. It takes only thirty minutes at most to convert a customer's photo into a mosaic tile map. This versatility allows them to compete in the custom mosaic industry for projects both large and small. The aim of this project is to help improve their assembly process.

Altaic's Original System



Missing and Misplaced Tiles

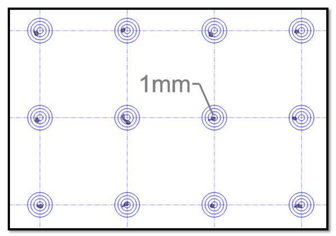
Understanding the Problem

In an attempt to understand the best way to help Artaic several tests where performed.

- Tile Placement Accuracy
- Robot Arm Positioning accuracy
- Sources of Error
- Tile Tolerance

Tile Placement Accuracy Test

The robot was programed to place a 10mm tile every 14 mm without the aid of placement grid that is normally used.



Fanuc Arm Positioning Accuracy Test

The robot was programed to make a dot with a marker every 14mm. The circles are concentric with the target points

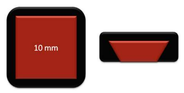
Test Results: Final tile location = Robot ± Tile ± Pick location tolerances
Final tile location = ±1.5 mm ± 2 mm ± 1mm = ± 4.5 mm

Test Conclusion: there is no way to improve the accuracy of the original system beyond a tolerance of ± 3.5 mm without replacing the robot or tile

Project Goals/Objectives

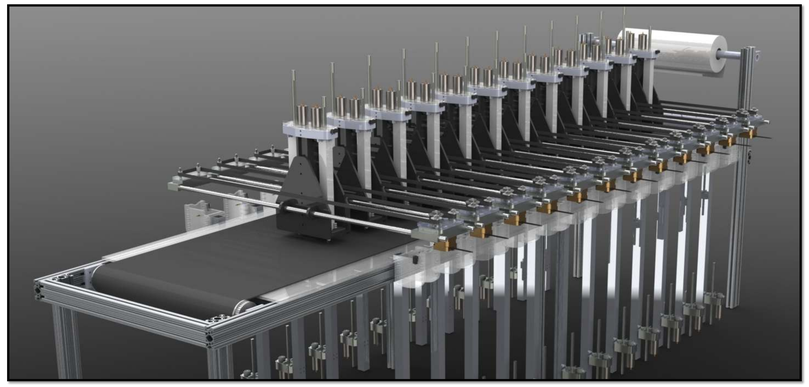
It is the goal of this project to design a new specialized robotic system, capable of handling the wide variety of tile that Artaic uses, with a much higher throughput. Specifications for the system include:

- Tile positioning accuracy < 0.1mm
- Open-ended tile geometry
- Greater than 8 square feet assembled per hour
- Compatibility with low quality, highly deformed, tile



Top and side views of common tile geometries

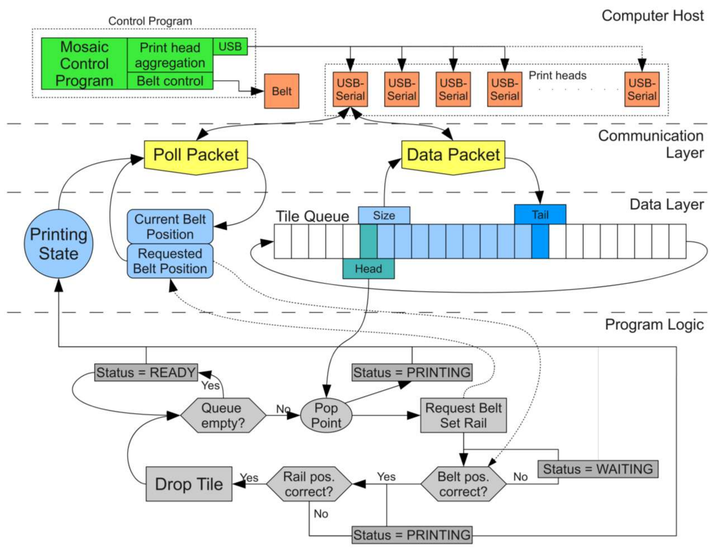
Tile Jet – Parallel Printer



The Tile Jet mosaic assembly robot is comprised of a virtually open ended number of tile placing sub-robots, each in charge of placing two different colors of tile onto a wide adhesive belt that traverses beneath them.

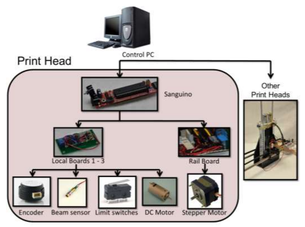
Development

The data layer separates the slave control program from the data link layer. The control program reads points from the queue and sets its current state. The link layer adds items to the queue and reads the state. The host control program polls the print head, and gets responses back. The print head never sends data without being prompted.



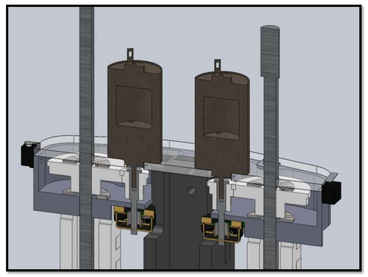
A diagram of the control program

Multiple controllers, placed on each print head, were used to manage the local motors and sensors. The Sanguino microcontroller monitors these localized controllers and communicates with the primary control program.

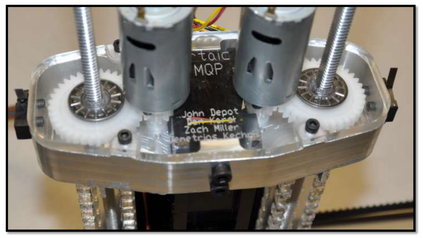


Interaction between system

The Tile Jet's major drawback is expense. Anytime a part or feature is added to a single print head the expense of that part gets multiplied by the number of print heads available. In attempt to keep the cost of the system reasonable the linear actuators used where custom designed to be producible on a tight budget while still allowing precise movement.



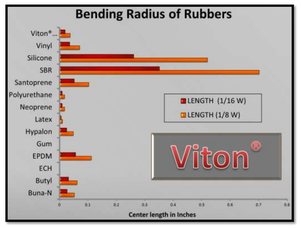
A CAD model of the print head



The core of the print head, the linear actuator controls the threaded rods that push tiles out of the robot

The diaphragm at the bottom of the cartridges was developed to accurately control the placement position of the tiles while center-justifying them. After running a series of tests the team came up with a diaphragm that would hold the tile while deflected with enough force that the stack of tiles sitting on it would be held up. The placement tolerance of the diaphragm was 0.8 mm per cm in height away from the surface.

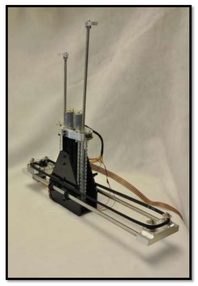
A 10 mm tile coming through a diaphragm test rig.



The results of our tests show we want a material that is flexible but not flimsy

Results

The team was able to realize a plausible interpretation of a print head that could be used as the foundation to the TileJ et printer. The team did not attempt to create multiple print heads or the belt table that connects the system together. The system has an expected output of between 15 and 30 square feet per hour depending on the mosaic



A completed print head

Conclusions/Recommendations

We have successfully laid the ground work for a new tile mosaic production system which can use a near infinite variety of tile with little to no modification. Further work is necessary to refine the control system, improve placement accuracy.

Acknowledgments

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