

A 3D printed Arduino-powered electronic Barth Sextic

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Purpose

To produce firmware for a snap-together Barth Sextic, a nodal algebraic surface with 65 double points, to show various symmetries using light.

Set Up

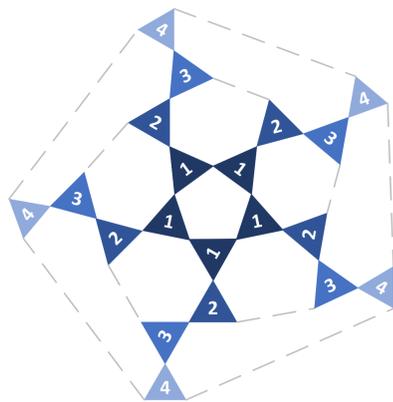
The model has ports for wires and coin-slot plugs for Neopixel Jewel 7-pixel RGBW chips that are powered by Arduino.



The controller activates the chips via switches, potentiometers, buttons, and a rotary encoder.

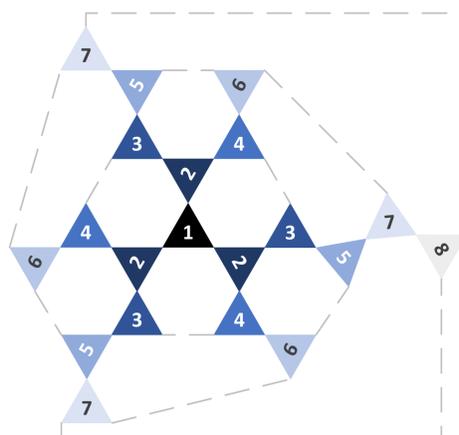


Five Fold Rotational Symmetry



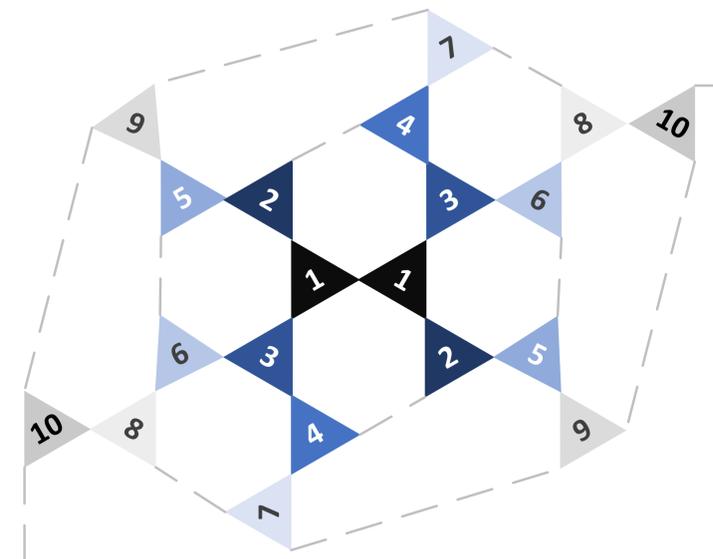
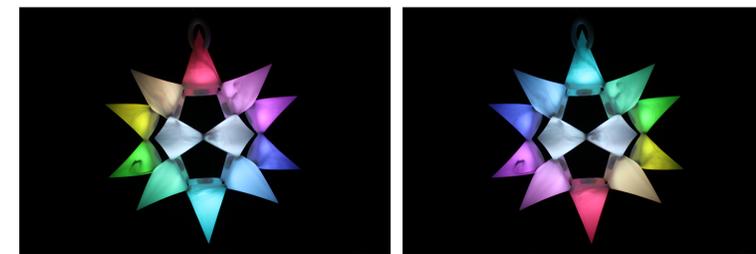
1. First iteration: choose five seed cones; the internal connections must form a pentagon.
2. Second iteration: select each connection to the seed cones.
3. Third iteration: find the rightmost connection from the second iteration cones.
4. Final iteration: find the leftmost connection to each cone from the third iteration.

Three Fold Rotational Symmetry



1. First iteration: pick one seed cone.
2. Second iteration: find each connection to the seed cone.
3. Third iteration: select the leftmost connection from the second iteration.
4. Fourth iteration: find the rightmost connection from the second iteration.
5. Create the fifth, sixth, seventh, and eighth iterations by stemming off the previous iterations.

Two Fold Rotational Symmetry



1. First iteration: pick two connected seed cones.
2. Second iteration: select the rightmost connection from the seed cones.
3. Third iteration: select the leftmost connection from the seed cones.
4. Repeat step 2 on the second and third iterations to form the fourth and fifth iterations.
5. Repeat step 3 on the third iteration to form the sixth iteration.
6. Stem off of iterations four, five, and six to form iterations seven, eight, and nine.
7. Final iteration: connect the remaining two cones.

References and Acknowledgements

- Github repository for firmware: github.com/amethystlab/sexticlighttoy
- Amethyst, Bates, Hao, Hauenstein, Sommese, Wampler. "Algorithm 976: Bertini_real: Numerical decomposition of real algebraic curves and surfaces". ACM TOMS.
- Weisstein, Eric W. "Barth sextic." From MathWorld – A Wolfram Web Resource. Accessed November 2021.

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