Scan of the Past

New Mexico

Supercomputing Challenge

Final Report

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Executive Summary

I chose this project based on my interest in facial reconstruction. After a teacher told me about the Supercomputing Challenge, I decided to try it out. I found there was a cultural problem excavating human remains of Northern American tribes. My goal for this project is to make it easer for anthropologists to figure out which tribe/pueblo the remains belong to on the computer, instead of disrespecting Native customs and damaging the skull.

The language that I chose was StarLogo. I figured that StarLogo would be an easier language to learn in the time allowed and also I could use the turtles as my points in creating a model of a skull.

What I learned was that my goal it was not going to be a small task. I realized that it was going to be somewhat difficult in StarLogo to have two shapes on one canvas, along with trying to make the shapes turn the same way at the same time. What also made this project difficult was trying to get the data, as in the measurements that I would be using.

As the first step in the project, I have accomplished so much. Although we can see the shapes next to each other, I need to give each of the turtles a specific x, y, and z positions so that I will be able to create the shape of the skull. My project is part of a multi-step program I hope to accomplish. When this project is complete, I hope it will be a valuable tool in the identification and repatriation of human remains.

Report

a. Problem Statement

Anthropologist and archeologist have a hard time categorizing Native American remains into certain ethnic groups. It is very important that the remains be returned properly and to the right group, because they are valued within the tribe.

After a skull is found, that area is closed off so that the remains are not disturbed. Then an anthropologist or archeologist is called. They look for artifacts that are located around the remains and use these as a tool for helping to identify where the human was from. Currently the only way remains can be identified is through artifacts. After the artifacts have been photographed, the photos are taken to the tribe to see if they can be identified. Problems may be created due to an incorrect identification or to inaccurate measurements. If anthropologist or archeologists considered making a3-D scan of the found remains, they may be more able to make a complete skull from the partial remains, on a computer.

b. *Method*

When human remains are discovered, an archeologist or anthropologist could collect the remains and bring them to a laboratory for analysis. This is where they are able to make the scan of the skull and analyze the measurements.

The “ideal” idea of the project is as follows:

1: Use a 3-D scanner to get the points for skull.

2: Use points as turtles to produce the 3-D model.

3: Make accurate measurements between any two points.

4: Compare dimensions to other known skulls in the data base.

5: Accumulated data base information to be used time and time again.

This is what I did for my project:

Step 1: A program was created in which two different skulls could be

compared.

Step 2: A StarLogo model called 3-D shapes was developed. 3-D shapes were chosen because the sphere was the closest shape to a skull and it was able to be rotated on its X, Y, and Z, axes. Also the turtles were shaded differently for thickness.

Step3: Use StarLogo, and be able to conduct comparisons.

Step4: The code was altered to scale and rotate object in X, Y, and Z

Next Challenge:

Step5: To have two objects side by side at one time, without having the shapes overlap.

Step6: To change the color of the right object, making it possible for the right shape to be red, and the left one to show as blue.

Step7: To place turtles on correct points to create the shape of a skull.

c. Results

With the lack of having the accurate measurements for the skull, I was not able to collect any reasonable data in the appointed time frame. Although unable to give my results now, I will present them at the expo.

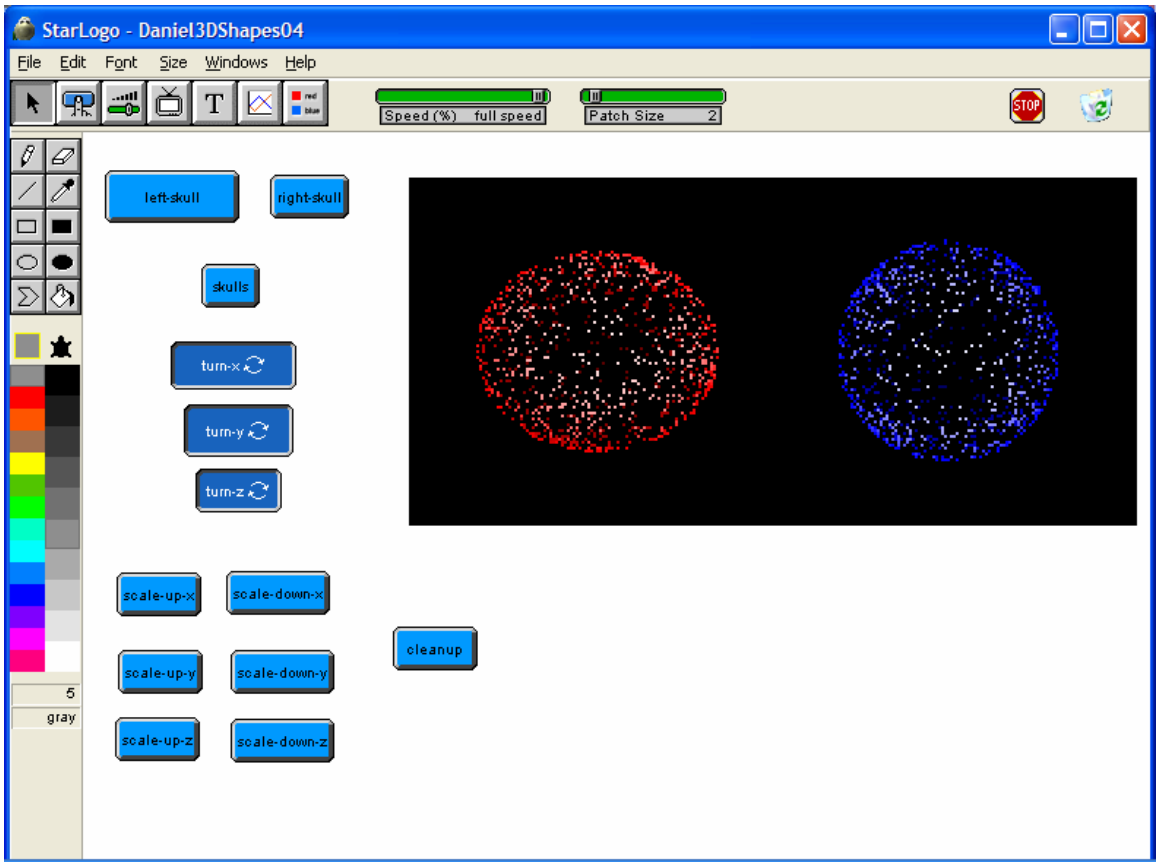
d. Conclusion

In conclusion I think that this project will have a positive outcome, with accurate data along with the possibility of returning the remains to the proper tribe.

Appendices

a. Screen shots

These are my screen shots that I have at the appointed time.



This is a picture of the two different models that were used as examples. Left model (shown in red) is wider than the right model. Right model (shown in blue) is another model. I will be comparing the two

b. StarLogo source code

Turtle command center code

```
turtles-own [
  x1          ; x position
  y1          ; y position
  z1          ; z position
  minz        ; minimum z value
```

```
    maxz                ; maximum z value
    vector-length       ; length of vector
]

;; sphere procedure
;; called by the observer sphere procedure
;; Gets normalized values for x, y, and z, sets minz and maxZ.
;; Then projects the turtle position on the xy-plane and scales
;; the turtle color to provide depth-cueing.
;;
to left-skull
        set-sphere-point srandom 50 srandom 50 srandom 50 40
        setminz -40
        setmaxz 40
        if breed = leftskull [project-on-left-xy]
end

to right-skull
        set-sphere-point srandom 50 srandom 50 srandom 50 40
        setminz -40
        setmaxz 40
        if breed = rightskull [project-on-right-xy]
end

;; project-on-xy procedure
;; called by the turtle sphere, cube, and cylinder turtle procedures
;; Positions the turtle at x1,y1 then scales the color according to depth (z)
;;
to project-on-left-xy
   if breed = leftskull [
        setxy (x1 - 60) y1
```

```
        scale-color red z1 minz maxz ]
end

to project-on-right-xy
   if breed = rightskull [
        setxy (x1 + 60)  y1
        scale-color blue z1 minz maxz ]
end

;; set-sphere-point procedure
;; called by turtle sphere procedure
;; takes four arguments: a random x, y, and z coord, and a fixed radius.
;; Computes the vector-length using pythagorean theorem
;; normalizes the vector to be of length radius.
;; then sets the values of the turtle parameters x1, x2, and x3
;;
to set-sphere-point :x2 :y2 :z2 :r
        setvector-length sqrt ((:x2 * :x2) + (:y2 * :y2) + (:z2 * :z2))
        setx1 :r * :x2 / vector-length
        sety1 :r * :y2 / vector-length
        setz1 :r * :z2 / vector-length
end



;; setxyz procedure
;; called by set-cube-point procedure
;; takes three arguments: the x, y, and z values to be loaded into
;; the turtle parameters.
;;
to setxyz :a :b :c
        setx1 :a
```

```
        sety1 :b
        setz1 :c
end


;; srandom procedure
;; called by set-cube-point procedure
;; returns a random value
;;
to srandom :foo
        output ((random (2 * :foo)) - :foo)
end


;; rotate-around-y  procedure
;; called by turn-y procdure
;; Sets the new x and z position as  if the turtle moved 1 degree in y,
;; uses fixed values rather than computing cos 1 and sin 1 repeatedly.
;;
to rotate-around-y
        setx1 (x1 * 0.9998477) - (z1 * 0.0175241)
        setz1 (x1 * 0.0175241) + (z1 * 0.9998477)
end

;; rotate-around-x  procedure
;; called by turn-x procdure
;; Sets the new y and z position as  if the turtle moved 1 degree in x,
;; uses fixed values rather than computing cos 1 and sin 1 repeatedly.
;;
to rotate-around-x
        sety1 (y1 * 0.9998477) - (z1 * 0.0175241)
```

```
        setz1 (y1 * 0.0175241) + (z1 * 0.9998477)
end

;; rotate-around-z  procedure
;; called by turn-z procdure
;; Sets the new x and y position as  if the turtle moved 1 degree in z,
;; uses fixed values rather than computing cos 1 and sin 1 repeatedly.
;;
to rotate-around-z
        setx1 (x1 * 0.9998477) - (y1 * 0.0175241)
        sety1 (x1 * 0.0175241) + (y1 * 0.9998477)
end
;; scale-x
;; called by the button called scale-x
;; makes the object larger in the x dimension

to scale-up-x
        setx1 x1 * 1.1
       project-on-left-xy
        project-on-right-xy
end

to scale-down-x
        setx1 x1 * 0.9
       project-on-left-xy
        project-on-right-xy
end


to scale-up-y
        sety1 y1 * 1.1
```

```
        project-on-left-xy
        project-on-right-xy
end


to scale-down-y
        sety1 y1 * 0.9
        project-on-left-xy
        project-on-right-xy
end


to scale-up-z
        setz1 z1 * 1.1
        project-on-left-xy
        project-on-right-xy
end


to scale-down-z
        setz1 z1 * 0.9
        project-on-left-xy
        project-on-right-xy
end

;; turn-y procedure
;; called by the button turn-y
;; rotates all the turtles around the y axis
;;
to turn-y
        rotate-around-y
```

```
        project-on-left-xy
         project-on-right-xy
end

;; turn-x procedure
;; called by the button turn-x
;; rotates all the turtles around the x axis
;;
to turn-x
         rotate-around-x
        project-on-left-xy
         project-on-right-xy
end

;; turn-z procedure
;; called by the button turn-z
;; rotates all the turtles around the z axis
;;
to turn-z
         rotate-around-z
        project-on-left-xy
         project-on-right-xy
end
```

c. Information window

WHAT IS IT?----------

This project shows how to create and rotate simple three-dimensional objects in StarLogo. Objects are created by placing turtles randomly on the surface of the object.

HOW TO USE IT----------

The SPHERE, CYLINDER, and CUBE buttons create those objects. The TURN-X, TURN-Y, and TURN-Z buttons make the objects rotate around the indicated axes.

THINGS TO NOTICE----------

Depth (along the Z-axis) is indicated by shade of red. Some objects (such as the cube) are easy to "see" from certain perspectives, but seem like a mess of turtles from other perspectives.

EXPLORATIONS----------

* Create other three-dimensional objects.*

Experiment with other ways of indicating depth along the Z-axis (other than shade of color).

To display the turtles on the two-dimensional screen, the turtles are projected directly onto the XY-plane (as if viewed from inifinity). Change the program so that the user can control the position of the "camera" (so that points with the same X and Y values do not necessarily project to the same place on the XY plane).* It is not always obvious how to distribute turtles evenly on the surface of a three-dimensional object. Try other ways of creating spheres and cylinders.

STARLOGO FEATURES----------

The TURN procedures use actual values rather than the trig. functions, since the trig lookup tables in StarLogo do not have as many digits of accuracy.

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