RECNT: Probability of Expressed Traits and Facial Recognition

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Introduction

In today's world, facial recognition and other biometric options are the latest hype sold to consumers through our various gadgets such as unlocking our phones with fingerprints or faces. We often don't ask ourselves how accurate and reliable is this technology. Through statistical analysis of expressed traits used in facial landmarking students will explore what computers are looking for and how common these traits are by themselves versus when you put two or more together. Students will also take their learning in facial landmarks into the engineering design processes, and try to spoof a facial recognition program.

Standards and Lesson Objectives

Standards:
State Standards: HS-LS3-3
ITEEA Standards: Abilities for a Technological World.11.N

Objectives:
After this lesson, students should be able to:

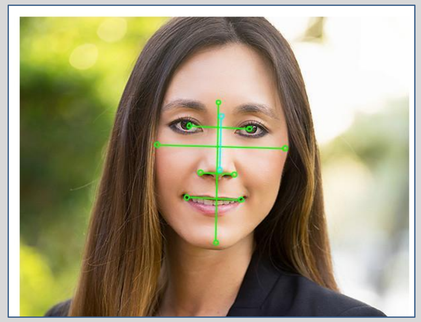
- Use math concepts to determine how common an expressed trait is.
- Explain in a general sense what facial landmarking is.
- Describe how they used the engineering design processes to spoof facial recognition

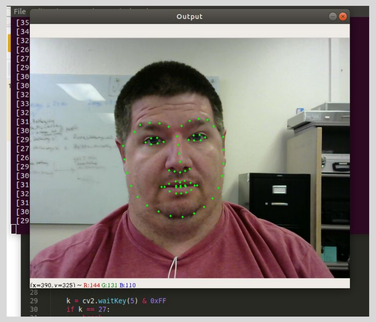
Probability and Traits

In genetics, probability can be used to predict and explain the variation and distribution of expressed traits in a population. With probability, we can determine the likelihood, given two crossbred organisms, that a certain trait or set of traits will occur in their offspring. We can also use probability to determine how likely a given trait occurs within a certain population.

Facial Landmarking Detection

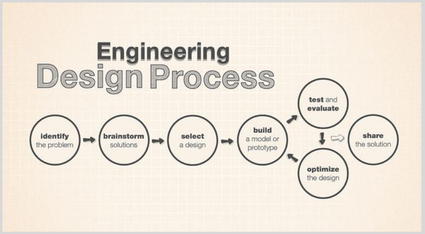
Facial landmark detection is where distinguishing points of a human face are detected within images or video through the use of machine learning and algorithms. This can be used for various other machine learning application such as facial recognition and now what is referred to as "deepfakes". Students will be using common facial measurements that also coincide with common points of facial landmarking detection as their basis for determining the variance of expressed traits in human faces. Students will first measure the distance between landmarks on photos of faces given to them, and then as a class, we will walk through finding average distances, and the probability that a certain measured distance for a landmark would fall into an average range for that landmark. Students will then repeat these steps with measurements from students in the class.





Activity

So you think you're a spy?



The design processes:

1. Identify the problem
   a. How can you spoof facial recognition?
2. Explore and brainstorm
   a. Students will play with a small neural network train to for facial and trait recognition and learn how it behaves
3. Design/ Create
   a. With their understanding of the neural network and facial landmarking students will design a disguise to match the same trait as their partner
4. Test and evaluate
   a. Students will use the neural network to test the design of their disguise.
5. Optimize
   a. Students will make modifications to their design to better fool the neural network.
6. Share solution
   a. Students will share their design with the class and in their report

Evaluation

Students will produce an activity report to explain the statistics they calculated on the facial landmarking measurements, where their partner's facial landmarking measurements fell in comparison to classroom averages, how this data informed their design processes on spoofing the facial recognition, if they were successful in their design, and how many changes to their design they did through the design process.