ENEE 408G Final Project Proposal

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We have included four potential ideas for our ENEE 408G final project. They are approximately in the order of our preference. We would like to get feedback about which idea would best match the final project guidelines for the course as well as the expectations for what must be completed by the end of the semester.

Project Idea 1:
Idea: File transfer app using user taken photos for encryption
Description: Inspired by Cloudfare's "lava lamp encryption" the goal of the project would be to design an app where a user taken photo is used as the cryptographic seed for encrypting a file before transfer.
Outline:

1. Design encryption algorithm
2. Design app

Potential additional components:

1. To further randomize the cryptographic seed a variety of randomly chosen filters could be put on images.
2. The randomness of these filters could be supported by instead having the user take a video and use the data points of the audiofile to choose a filter for the image.

Potential Challenges:
This group does not have an extensive knowledge of cryptography and will likely have to do a good bit of front end research to ensure the idea is generating significantly secure encryption.
References:
Lava Lamp encryption: https://www.cloudflare.com/learning/ssl/lava-lamp-encryption/

Project Idea 2:
Idea: Intelligent resolution adjustment for security cameras
Description: To help with minimizing storage space required for home security cameras the goal would be to implement a motion detection algorithm that will increase the resolution when motion is detected. This will allow the largely static video to be at a lower resolution and save storage space.
Outline:

1. Design motion detection algorithm
2. Implement algorithm in webcam or other home security camera equivalent

Potential additional components:

1. Facial recognition and saving of detected faces when motion is detected
2. Gesture detection to allow the security camera to perform actions when gestured at.
    a. Useful for simple control applications as well as alerting authorities in the case of a user who is unable to alert the authorities themselves.

Potential Challenges:
Testing this idea in various scenarios might prove challenging with the time frame of the project.

Project Idea 3:

Idea: Estimate speed of moving objects in video using Machine Learning

Description: Ideally, a user with a phone would be able to select an object visible in the camera and record a video. After finishing the video, the app would calculate the speed of the object by determining the distance it moved over a set number of frames. The app could also tell the user how far the object moved during the video.

Outline:

1. Prototype a motion tracking (of a selected object) algorithm in MATLAB
2. Use Open Source Computer Vision Library (OpenCV) to convert the prototype algorithm into C++ or Python
3. Design an app where the user can take a video--with the camera stationary--and the app will output the object data to the screen and a file.

Potential additional components:

1. Allow the user to track an object while the the camera is moving
    a. Case 1: Camera is moving but the object is not
    b. Case 2: Camera is moving and the object is moving
2. Show predicted trajectories based on the speed of the object
3. Detect the a moving object without the user having to define it

Potential Challenges:

1. Even with a stationary camera there will be stabilization issues that will make motion tracking difficult
2. Having enough training data to accurately detect and measure motion will be challenging to acquire in the time frame of this project
3. Analyzing a 2D video in a way that translates to 3D motion will likely prove the most challenging component.

Project Idea 4:

Idea: Faces (or objects) as signals

Description: Take a face and convert it into a signal representation. This would be done by simplifying the face to a simple shape that could be drawn (by epicycles) with ~100 points. Those epicycles would then be converted into sinusoids.

Outline:

1. Design a facial detection algorithm
2. Design an edge detection algorithm that can create a simple outline of the face
3. Use a traveling salesman algorithm to make the outline into one continuous path
4. Design an algorithm to draw this outline with epicycles
5. Convert the epicycle representation into sinusoids that can be converted back to the epicycle drawing
6. Design an app that allows users to convert back and forth between the drawing and the signal representation

Potential additional components:

1. Add augmented reality capabilities to the app that will display the drawing on the object on person in 3D space
2. Design different ways to represent the epicycles in different domains that are not necessarily as abstract as sinusoids
3. Develop a way to analyze the output signal as audio and determine the shape of the original drawing based on the audio **(highly ambitious)**

Potential Challenges:

Because this project involves numerous different components of signal processing it could be at any point too difficult to get all of them to work together.

References:

Mathologer: https://youtu.be/qS4H6PEcCCA
The Coding Train: https://youtu.be/Mm2eYfj0SgA
Jezmoon: http://www.jezzamon.com/fourier/index…
3Blue1Brown: https://www.youtube.com/watch?v=r6sGWTCMz2k&list=WL&index=8&t=0s