Team Information
Project title : PsycheGeometries
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Project summary : An AI-powered system that interprets human emotions via neural networks to generate unique, dynamically evolving fractal visualizations reflecting inner states.
Project Description

- **Short description:**
  An interactive application that uses a webcam to analyze the user's facial expression in real-time, interprets their emotional state in terms of valence and arousal, and translates these feelings into a continuously evolving, unique 2D fractal visualization displayed on screen.
- **A rough sketch of the design:**
  1. **Input:** The system continuously captures video frames from the user's webcam.
  2. **Processing:**
     - **Face Detection:** Locates the user's face in the video frame.
     - **Emotion Analysis:** Analyzes the facial features using a pre-trained neural network model to estimate two continuous emotional dimensions:
       - **Valence:** How pleasant or unpleasant the emotion appears (e.g., smile vs. frown).
       - **Arousal:** How intense or activating the emotion appears (e.g., wide eyes, raised eyebrows vs. neutral).
     - **Mapping:** The calculated Valence and Arousal values are mapped to specific parameters controlling the fractal generation. For example:
       - *Valence* could control the **color palette** (e.g., high valence = warmer/brighter colors, low valence = cooler/muted colors) and perhaps subtle **structural elements** (e.g., smoother vs. sharper edges).
       - *Arousal* could control the **complexity** (e.g., iteration depth of the fractal), the **speed of change/animation**, or the **zoom level/dynamic movement** (e.g., high arousal = faster changes, more intricate details, pulsing effect).
     - **Fractal Generation:** A 2D fractal algorithm (e.g., Julia Set, Mandelbrot variations, or IFS) is computed in real-time using the parameters derived from the emotion analysis.
  3. **Output:** The resulting fractal pattern is rendered dynamically and displayed on the user's screen, constantly updating as their detected expression changes.
- **Is there any interaction?**
  Yes, the primary interaction is **implicit and continuous**: the user's facial expression directly influences and changes the visual output in real-time. The user interacts simply by *being* and *feeling* (or at least, expressing facially) in front of the camera. We could potentially add a simple secondary interaction, like a button to **"freeze" or "capture"** a particularly interesting fractal state generated from a specific moment's emotion.
- **What feelings to you aim to elicit to the participants?**
  We aim to elicit feelings of:
  - **Curiosity:** About how their own face and expressions translate into abstract visual patterns.
  - **Self-reflection/Introspection:** Encouraging users to observe the connection between their perceived inner state (or at least facial display) and the external visualization.
  - **Wonder/Aesthetic Appreciation:** At the beauty and complexity of the generated fractal patterns driven by something as personal as emotion.
  - **Engagement:** Through the real-time, dynamic feedback loop between user expression and visual output.
  - Potentially **Calmness or Energy:** Depending on the emotional state detected and the corresponding visual mapping (e.g., seeing a calm expression generate smooth, harmonious patterns might reinforce calmness).
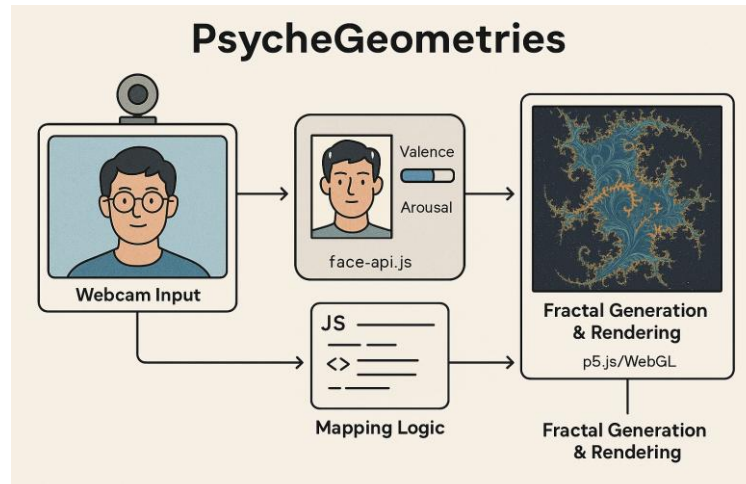
This is a demo of our proposed project. It captures human emotions from WebCam, and decode the facial expression into two dimensions, valence and arousal, which are then mapped to the fractal shapes.

Technology

- **What tech do you think you might want to use?**
  - **Platform:** Web-based application like p5.js (for accessibility).
  - **Core Language: JavaScript**.
  - **Libraries/APIs:**
    - **Face Detection & Emotion Analysis:** A JavaScript library like `face-api.js` (built on TensorFlow.js, can run in the browser, capable of detecting faces, landmarks, and expressions, potentially mappable to Valence/Arousal).
    - **Fractal Generation & Rendering: `p5.js`** is excellent for creative coding, graphics, and handling the rendering loop easily. Alternatively, direct **WebGL** could be used for higher performance. **NumPy** logic ported to JS or specialized JS math libraries might be needed for efficient fractal calculations.
  - **Hardware:** A standard computer or mobile device with a front-facing camera and a modern web browser supporting WebRTC and WebGL/Canvas.

Motivation

- **How did you come up with this idea?**
  At the very beginning, the idea of emotion recognition (a common AI application) and fractal art (a visually striking generative medium) are two separate ideas of our project. In brainstorming session with partner, we came up with an idea that we can combine emotion recognition and fractal art. That is how this "PsycheGeometries" was born.
- **How did you become interested in this idea?**
  Interest stems from a fascination with bridging the gap between the internal, subjective world of human emotion and the external, objective language of computation and mathematics. It combines:
  1. The power of AI (specifically computer vision and affective computing) to interpret subtle human cues.
  2. The inherent, infinite beauty and complexity found in fractal geometry.
  3. The desire to create personalized, dynamic art that isn't just decorative but reflective of the viewer's own state, offering a novel form of self-expression and bio-visualization.
  4. Curiosity about how visualizing emotions might impact self-awareness or even emotional regulation.
- **Visual reference:**
  - **Link to an example fractal artwork:** https://www.jq22.com/code3038
  - **Generative Art:** Artists like *Manolo Gamboa Naon* or *Tyler Hobbs* who use algorithms to create complex, evolving visual systems.
  - **Fractal Art:** Dynamic renderings of Julia Sets or Mandelbrot zooms where parameters change over time (search "Julia set animation"). Imagine these changes being driven by emotion data instead of pre-programmed sequences.
  - **Biofeedback Visualizations:** Systems that visualize physiological data like heart rate or brainwaves (e.g., Muse meditation headband visualizations), but applying this concept to facial expressions and mapping it to fractal aesthetics instead of simpler graphs or ambient colors.
  - *Example search terms for inspiration:* "affective computing visualization," "emotion generative art," "real-time fractal generator p5js," "face-api.js expression demo."