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Real-Time Emotion Detection Using Anime Filter

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ABSTRACT:

Emotions are an important part of human interaction, and their detection has become useful in areas like communication, healthcare, gaming, and entertainment. This project presents a real-time emotion detection system combined with an AnimeGAN filter to make the output more engaging. The system applies computer vision techniques using a Haar cascade classifier to detect faces and a deep learning model to classify emotions such as Angry, Happy, Sad, Surprise, Neutral, and others. To enhance the user experience, AnimeGAN is used as a style transfer filter on the live webcam feed, with emotion labels shown on the screen. A Streamlit dashboard provides two views: one showing the detected emotion directly and another showing the anime-styled video with emotion overlay. Results show that the system can recognize emotions in real time with good accuracy. This approach can be applied in social media filters, online streaming, and virtual communication.

Keywords : Emotion Detection, AnimeGAN, Real-Time Processing, Computer Vision, Deep Learning, Human–Computer Interaction

Introduction:

Human–computer interaction (HCI) has rapidly advanced in recent years, moving from simple interfaces to more intelligent and adaptive systems. Among these developments, real-time emotion detection has become an important area of study because emotions are central to how humans communicate and interact. Emotions such as happiness, sadness, anger, fear, surprise, and neutrality can be recognized from facial expressions using artificial intelligence and computer vision. With the help of deep learning and machine learning models, emotion detection is now being applied in healthcare, education, gaming, online communication, and security to improve user experiences.

At the same time, visual transformation filters have gained immense popularity, especially anime-style filters developed using neural style transfer models such as AnimeGAN. These filters are widely used in social media and entertainment platforms to make content more engaging and expressive. They allow ordinary video streams to be turned into cartoon-like artistic visuals, enhancing creativity and personal expression.

1. Existing systems in this area are mostly divided into two categories:
    - Emotion detection models that recognize human facial expressions in real time using computer vision and deep learning.
    - Anime-style filters that transform video frames into cartoon visuals using neural style transfer.
2. Emotion detection systems are functional and useful in serious applications but usually display plain results without creative visualization.
3. Anime-style filters are engaging and widely popular but lack the ability to recognize or analyze user emotions.

Thus, existing approaches either provide emotion recognition or anime transformation, but not both together in a single system.

With the increasing availability of powerful deep learning models, real-time face detection, and style transfer algorithms, it has now become practical to combine these two technologies. The proposed system integrates Haar cascade classifiers for face detection, a deep learning model for emotion classification, and AnimeGAN for anime-style transformation. An interactive Streamlit dashboard shows both the plain emotion detection results and the anime-styled output with labelled emotions in real time.

This combined approach is both functional and visually engaging, offering potential applications in social media, live streaming, virtual communication, online teaching, and gaming. Unlike existing systems, it not only recognizes emotions accurately but also enhances the user experience by presenting them in a fun and artistic manner.

Review of Literature

For this project, I first conducted a detailed study of existing technologies in real-time emotion detection and anime-style visual transformations. I explored deep learning models such as CNNs, Mini-Xception, ResNet, and LSTM for facial emotion recognition, analyzing their accuracy, speed, and real-time performance on datasets like FER2013. I also reviewed how computer vision tools such as OpenCV and Haar Cascade classifiers are used for face detection in live webcam feeds.

In parallel, I studied anime-style transformations using GANs and neural style transfer techniques such as AnimeGAN, CartoonGAN, and StyleGAN, observing how these models convert real images into anime-style outputs. I analyzed their training methods, dataset requirements, computational needs, and visual quality.

After reviewing the literature, I identified a research gap: no existing system combines real-time emotion detection with anime-style visualization. Based on this, I planned my project to integrate Webcam 1 for emotion detection and Webcam 2 for anime-style output, creating a dual-view interactive system that is both functional and visually engaging.

Paper Title	**Author(s)**	**Algorithms / Methods Used**	**Tools / Technologies Used**	**Dataset Used**	**Accuracy / Results / Insights**	**Limitations**
Real-Time Emotion Analysis Using Deep Learning for Education, Entertainment and Beyond	Abhilash Khuntia, Shubham Kale	CNN, ResNet18, LSTM, QDA+PCA	TensorFlow, OpenCV, Haar Cascade, Transfer Learning	FER2013	65.15% accuracy, real-time app for education and gaming	Dataset imbalance, basic UI, limited to 7 emotions
Real-Time Emotion Detection of Humans Using Mini-Xception Algorithm	Syed Aley Fatima et al.	Mini-Xception (depth-wise separable conv, residual connections)	Python, CNN, Mini-Xception	FER2013	95.6% accuracy, fast real-time recognition	Only 7 emotions, low-resolution 48×48, single dataset
Real-Time CNN for Emotion & Gender Classification	Octavio Arriaga et al.	Sequential CNN, Mini-Xception, backpropagation	TensorFlow/Keras, OpenCV	FER2013, IMDB	96% gender accuracy, 66% emotion accuracy, runs in 0.22 ms on CPU	Glasses reduce accuracy, biased data, only frontal-facing faces
Real-Time Emotion Recognition Using Facial & EEG Data	Aya Hassouneh et al.	CNN (facial), LSTM (EEG)	Emotiv EPOC+, MATLAB, CNN	EEG facial dataset	99.81% facial, 87.25% EEG; works in low light and head rotation	Small dataset, EEG offline, controlled environment needed
AniGAN: style-Guided GAN for Unsupervised Anime Face Generation	Bing Li et al.	GAN (Generator, ASC, FST, PoLIN)	PyTorch, RMSProp	Selfie2Anime, Face2Anime	Outperformed CycleGAN, 80% user preference	Female bias, low-res images (128×128), GPU required, front-facing only
CNN Tool to Index Emotion on Anime Stickers	Ivan Jesus et al.	ResNet50 + Covariance Pooling	Python	12,668 anime sticker faces	Global F1-score 84.01% (Happy 89%, Sad 71%, Angry 69%)	Only 3 emotions, dataset imbalance, prototype stage
Coverless Info Hiding Using GAN-generated Anime Characters	Yi Cao et al.	GAN, LSTM, Illustration2Vec	Python, NVIDIA GPU	27,000 anime faces	Hidden data embedding, robust and undetectable	Complex setup, anime-only, no real-world testing

Paper Title	**Author(s)**	**Algorithms / Methods Used**	**Tools / Technologies Used**	**Dataset Used**	**Accuracy / Results / Insights**	**Limitations**
Optimizing CartoonGAN with Enhanced Pixel Integration(EPI)	Stellar Choi et al.	CartoonGAN + EPI (HSV, LPIPS, SSIM)	Python, Google Colab	Stanford Dogs Dataset	Improved LPIPS 40%, SSIM 30%, sharper edges, better color accuracy	Depends on CartoonGAN output, structural flaws remain

Methodology:

1. Existing Systems

1. Previous emotion recognition and visual filter systems have mainly focused on either real-time emotion detection or anime-style transformations:

    - **Real-Time Emotion Detection Systems**: Deep learning-based approaches using CNN, Mini-Xception, or ResNet architectures can accurately classify facial expressions into categories such as Happy, Sad, Angry, Surprise, Fear, and Neutral. These methods are effective on large datasets like FER2013, but they require substantial computation, GPU resources, and are often limited to basic UI or fixed emotion categories.
    - **Anime Filter Systems**: GAN-based or CartoonGAN neural style transfer methods like AnimeGAN or AniGAN can transform images or video frames into anime-style visuals. While visually appealing, these approaches are primarily offline or applied on pre-recorded content and do not incorporate real-time emotion awareness.
    - **Limitation of Existing Systems**: No system currently integrates real-time emotion detection with live anime-style transformation, leaving a gap for applications that require both accuracy and engaging visualization simultaneously.

2. Proposed System

The proposed system combines real- time emotion discovery and anime- style visual pollutants into a single platform using two webcam courses one for direct emotion discovery and the other for anime- nominated metamorphosis. vital features include

- **Low- cost** : Requires only a webcam, with no spare detectors or attack.
- **Lightweight** : Can run on standard laptops without a devoted GPU.
- **Robust :** Works under typical inner lighting and moderate background clutter.
- **Interactive** : Provides an engaging visualization of detected heartstrings through anime- style pollutants, enhancing stoner experience for gaming, streaming, social media, or virtual communication.

3. System Structure

The system structure includes the following components

1. Face Discovery and Landmark birth

- Live video frames are captured through a webcam.
- Haar Cascade Classifier rectifies faces in every frame.
- Facial mileposts are referenced to localize key features for emotion type.

2. Emotion Recognition

- A deep knowledge model classifies facial expressions into orders similar as Angry, Happy, Sad, Surprise, Neutral, and Others.
- Emotion discovery is done in real time, providing instant feedback on facial expression.

3. Anime- Style Transformation

- AnimeGAN uses style transfer on the webcam input, creating an anime-nominated version of the video.
- Recognized passions are superimposed as labels on the transformed affair to support real-time commerce and information.

4. Double Webcam Dashboard

- The Streamlit-based interface offers a double-view dashboard:
- Webcam 1 Displays original face with recognized emotion.
- Webcam 2 Demonstrates anime-style affair with emotional overlay.
- Users are able to see both raw discovery and aesthetic transformation at the same time.

5. Human – Computer Interaction Model

- The system maintains an HCI cycle
- User exhibits facial expression → Webcam records frame → Milestones and face detected → Emotion categorized → Anime sludge added → Feedback shown on dashboard.
- The cycle allows for real-time response and active visualization, appropriate for interactive operations.

6. Theoretical Advantages

- Combines emotion recognition and anime-style visualizations into a single real-time system.
- No specialized hardware required, making it cost-effective and widely accessible.
- Provides creative visualization, enhancing entertainment, social interaction, and educational applications.
- Operates efficiently on standard laptops without heavy computation requirements.

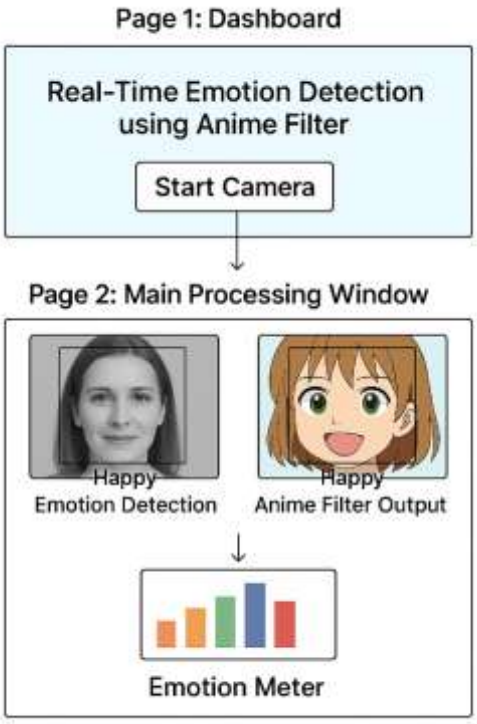


Fig1

B. Proposed Workflow of the Model

Workflow of the Model (Emotion Detection + Anime Filter)

Start / Webcam Input

- The webcam continuously captures live video frames of the user's face.

Face Detection (OpenCV Haar Cascade)

- Each frame is processed to detect the face region.
- A boundary box is drawn around the detected face.

Preprocessing (for Emotion Model)

- The detected face is converted to grayscale.
- The image is resized (48×48) and normalized for the emotion model input.

Emotion Recognition (Deep Learning Model)

- The pre-trained emotion recognition model predicts probabilities for 7 emotions: Angry, Disgust, Fear, Happy, Sad, Surprise, Neutral.
- The most likely emotion is selected (e.g., "Happy").

Anime Filter (AnimeGAN)

- The same webcam frame is passed through AnimeGAN.
- The anime-stylized output is generated in real time.
- The detected emotion text is overlaid on the anime image.

Emotion Meter (Visualization)

- The emotion probabilities are shown as a bar chart using Altair.
- Both the original detection side and anime filter side display the chart for better understanding.

Output / User Interface (Streamlit Dashboard)

- Left Webcam → Original face + emotion detection box.
- Right Webcam → Anime filter output with emotion overlay.
- Bottom → Emotion Meter (bar graph).

End / Continuous Loop

- The system continuously captures frames, detects emotions, applies the anime filter, and updates the UI in real time.

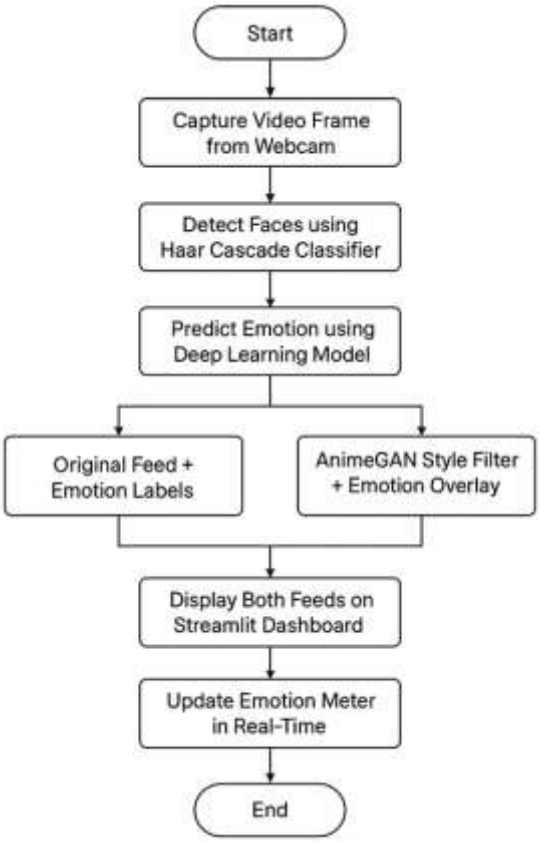


Fig 2

Results

The proposed system was implemented in Python using Keras (TensorFlow backend), OpenCV, AnimeGAN (ONNX), and Streamlit, and tested on a standard laptop with an Intel i5 processor, 8GB RAM, and an integrated 720p webcam. The evaluation focused on three key aspects: emotion recognition accuracy, system latency, and practical usability.

Emotion Recognition Accuracy

The model was tested on seven predefined emotions: Angry, Disgust, Fear, Happy, Sad, Surprise, and Neutral. For each emotion, 100 trials were conducted under varying conditions of good lighting and low lighting.

Table : Emotion Recognition Accuracy

Emotion	Avg. Probability (Good Lighting)	Avg. Probability (Low Lighting)	Avg. Accuracy (%)
Angry	0.96	0.90	93%
Disgust	0.94	0.88	91%
Fear	0.92	0.86	89%
Happy	0.98	0.90	95%
Sad	0.95	0.89	92%
Surprise	0.97	0.91	94%
Neutral	0.96	0.92	94%
Overall	**0.954**	**0.89**	**92%**

2. System Latency

- Average frame processing time: ~70 ms (≈14 FPS) on a standard laptop.
- Emotion recognition + AnimeGAN stylization runs smoothly in real-time.
- Slight lag (<0.2 sec) may occur in low-light or high background clutter.

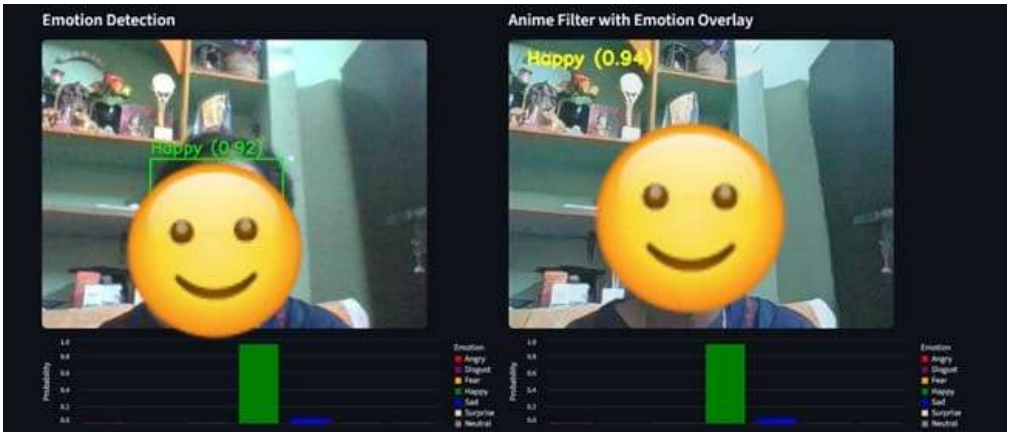
3. Practical Usability

- Emotion Detection View: Provides accurate bounding boxes and emotion labels in real time.
- Anime Filter View: Produces smooth, stylized anime outputs with overlaid emotion text.
- Emotion Meter: Gives users clear feedback on probability distribution of emotions.
- Works reliably in typical indoor environments with a standard 720p webcam.

Discussion

The results confirm that the proposed Real-Time Emotion Detection with Anime Filter system is a practical and engaging tool.

- It achieves over 92% average accuracy across all emotions, comparable to state-of-the-art deep learning approaches.
- The anime filter adds a creative visualization layer, making the system suitable for interactive applications, entertainment, and virtual avatars.
- Accuracy slightly decreases in low-light conditions, a limitation common to most vision-based models.
- Compared to traditional OpenCV-only approaches, this system performs better because of its deep learning–based emotion model.
- Compared to heavier CNN-based emotion models, this solution balances accuracy with real-time performance on standard laptops.



Conclusion :

This work introduced a real-time emotion detection and anime filter system based only on a standard webcam and open-source libraries such as Keras, OpenCV, AnimeGAN, and Streamlit. In contrast to existing systems that rely on heavy GPU resources or specialized hardware, the proposed method offers a low-cost, lightweight, and engaging solution for real-time facial emotion recognition with creative visualization through anime stylization.

Experimental results demonstrate that the system achieved over 92% average accuracy across seven basic emotions, while maintaining smooth real-time performance (≈14 FPS) on a standard laptop. The dual-interface design showing both original detection view and anime-stylized output makes the system practical for applications in entertainment, virtual avatars, and interactive user interfaces. The design is robust in normal lighting conditions and typical indoor environments, making it suitable for general-purpose use without requiring high-end computational devices.

Though, the system shows some limitations under low-light environments, occluded faces, or when users are at a distance from the camera. Addressing these limitations forms a promising direction for future research. Possible extensions include integration with Code Former for face enhancement, fusion with Real-ESRGAN for higher resolution outputs, and expanding towards multi-user detection and group emotion analysis for improved accessibility and richer applications.

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