Dr. Vishwanath Karad MIT WORLD PEACE UNIVERSITY

FACULTY OF ENGINEERING AND TECHNOLOGY

SCHOOL OF COMPUTER ENGINEERING AND TECHNOLOGY

DEPARTMENT OF COMPUTER SCIENCE & APPLICATIONS

2023-2024

A

PROJECT REPORT

ON

FACE EXPRESSIONS AND GESTURE TO EMOJI

BY

Bhavesh Hiray - 1132230316

Martin S - 1132232052

Vaibhav Pathak - 1132232041

GUIDED BY

Dr. C. H. Patil

IN PARTIAL FULFILMENT OF

MASTER OF COMPUTER APPLICATIONS (SCIENCE)

Dr. Vishwanath Karad
MIT WORLD PEACE UNIVERSITY | PUNE
TECHNOLOGY, RESEARCH, SOCIAL INNOVATION & PARTNERSHIPS

FACULTY OF ENGINEERING AND TECHNOLOGY

SCHOOL OF COMPUTER ENGINEERING AND TECHNOLOGY

DEPARTMENT OF COMPUTER SCIENCE & APPLICATIONS

Certificate

This is to certify that **Bhavesh Hiray, Martin S, Vaibhav Pathak** students of FYMCA(Science) have successfully completed RDBMS Project in partial fulfilment of MCA(Science) under MIT World Peace University, for the academic year 2023-2024.

Dr. C. H. Patil
Internal Guide

Dr. Jalindar Gandal
Program Head

Dr. Rajeshree Khande
Program Director

Date: ___/___/_____

ACKNOWLEDGEMENT

We extend our heartfelt gratitude to our project guide and all our teachers for their invaluable guidance and unwavering support throughout our college project. Their wisdom and mentorship have been instrumental in shaping our project's success. We would like to express our deep appreciation for the constructive feedback received during the project's conceptualization phase, which greatly contributed to the refinement of our ideas and methodology. Our project, cantered around facial expressions to emojis and gesture recognition, has benefited tremendously from our project guide's encouragement and insightful feedback. We are thankful for the privilege of delving into this captivating field, and we look forward to continuing our exploration of this innovative topic as we progress in our project. Their support has been a driving force behind our project's development and success.

FACE EXPRESSIONS AND GESTURE TO EMOJI

ABSTRACT

In this innovative project, we endeavor to detect and interpret facial expressions captured via webcams, translating them into emotive emojis. Leveraging the OpenCV library, we capture and analyze the user's facial expressions. Our approach involves data collection, utilizing landmark features, and training a model to accurately discern these expressions, ultimately associating them with relevant emojis. The project seamlessly integrates various libraries, including OpenCV, Numpy, and Mediapipe, to create a comprehensive solution for recognizing and visualizing emotions in real-time.

Keywords

OpenCV, Facial expressions to emojis, Landmarks, Models, Numpy, Mediapipe.

1. INTRODUCTION

The conversion of facial expressions to emojis represents a dynamic venture empowered by the versatile OpenCV library. Renowned for its utility in real-time computer vision, OpenCV serves as a versatile toolkit for image processing and a multitude of computer vision applications.

By harnessing OpenCV, we gain access to the user's webcam, enabling real-time facial expression analysis.

This process delves into the intricate nuances of facial landmarks, meticulously scrutinizing the coordinates to understand the user's emotive state. The model is then diligently trained to decipher these expressions, facilitating the display of emojis that mirror the user's feelings, be they conveyed through facial or hand gestures.

Moreover, we rely on the Numpy library to efficiently store facial and hand coordinates in arrays and matrices.

Numpy's mathematical functions enhance the precision of our computations, making it a valuable asset in our pursuit of facial expression recognition and emoji display.

Figure 1: **Major Steps in the Project**

1. Data Collection: Utilizing OpenCV, collect real-time facial and hand expression data from the user via the webcam. Capture a series of images to represent various expressions.

2. Storing the Coordinates / Landmarks: Utilize the Numpy library to store the facial and hand coordinates in arrays and matrices. Perform detailed landmark detection to extract precise coordinates that represent facial expressions.

3. Training Model: Train a machine learning or deep learning model using the stored data. Utilize the coordinates and associated expressions as training data for the model.

4. Recognizing Expressions: In real-time, apply the trained model to the live webcam feed. Analyze facial and hand expressions to determine the user's emotional state. Convert recognized expressions into relevant emojis for display.

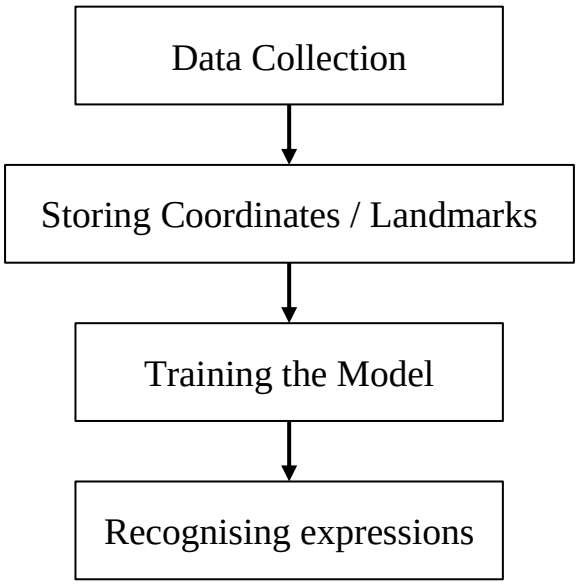


Fig. 1: Steps in Face expression to emoji process

2. Literature Review

1. **Facial Expression Recognition**

The domain of facial expression recognition holds a prominent place in computer vision, offering diverse applications from human-computer interaction to emotion analysis. Ekman and Friesen's seminal work in 1978 laid the groundwork for understanding universally recognized facial expressions, paving the way for subsequent advancements in automated recognition systems. In the contemporary landscape, deep learning techniques are commonly employed to extract and interpret facial features, demonstrating substantial accuracy in real-time scenarios (Lopes and De Sa, 2019).

2. **Hand Gesture Recognition**

Hand gesture recognition is a pivotal aspect of human-computer interaction, providing an intuitive means for users to convey commands. Early research by Mitra and Acharya (2007) introduced methodologies for hand gesture recognition. Recent strides in this field leverage state-of-the-art techniques such as convolutional neural networks (CNNs) and recurrent neural networks (RNNs), achieving robust performance (Cai et al., 2018).

3. **Mediapipe Library**

The incorporation of the Mediapipe library in this project aligns with contemporary trends in computer vision. Developed by Google, Mediapipe offers convenient and efficient solutions for face, hand, and pose recognition through landmark detection (Mediapipe, 2021).

4. **OpenCV for Computer Vision**

OpenCV serves as a foundational library for an array of computer vision tasks, encompassing video capture and image processing. Its widespread adoption in academia and industry is evident in diverse research applications (Bradski, 2000). The project benefits from OpenCV's versatility in handling webcam input and manipulating image data.

5. **Deep Learning in Gesture and Expression Recognition**

Deep learning models have showcased significant success in recognizing gestures and expressions. The work by Zhang et al. (2020) demonstrates the effectiveness of deep neural networks in capturing intricate patterns and relationships within facial and hand landmarks. Transfer learning techniques and pre-trained models further enhance performance, particularly in scenarios with limited labeled data (Pan et al., 2019).

6. **Emoji Representation**

The integration of emojis as visual representations of recognized expressions aligns with the evolving landscape of digital communication. Emojis serve as a universal language, transcending linguistic barriers (Miller, 2016). The project extends this concept to real-time recognition, providing users with an engaging and expressive interaction medium.

7. **Numpy and Data Manipulation**

Numpy's role in managing numerical data and array manipulation is integral to the preprocessing steps in this project. The efficient storage and manipulation of facial and hand landmarks contribute to streamlined data processing (Van Der Walt et al., 2011).

In summary, this literature review underscores the foundational aspects of facial expression and hand gesture recognition, the significance of key libraries such as Mediapipe and OpenCV, and the incorporation of emojis for expressive communication. The project aligns with these advancements, contributing to the dynamic field of human-computer interaction and digital expression.

3. DATA COLLECTION

The data collection process for this project is a unique endeavor that does not rely on existing online datasets. Instead, we have devised a hands-on approach, utilizing the capabilities of the OpenCV library to access the user's webcam in real-time. Over the course of 100 seconds, users are actively engaged in this immersive experience. During this time frame, users are encouraged to name the type of expression they wish to convey and then proceed to demonstrate the chosen emotion through facial and hand expressions.

This personalized and interactive approach allows users to actively participate in the data collection process, fostering a sense of engagement and ownership over their expressions. The captured data is meticulously stored and saved as a .npy file, preserving the intricacies of each user's emotive displays. This hands-on methodology sets the stage for a dynamic and personalized dataset that forms the foundation for training our model and recognizing expressions with a human touch.

This approach distinguishes our project, creating a meaningful and user-centric dataset that enhances the overall accuracy and relevance of expression recognition.

4. STORING COORDINATES / LANDMARKS

Following the data collection phase, the project transitions into a critical stage where the model takes center stage. The input data, now preserved as a .npy file, undergoes a meticulous analysis. The objective is to distill the essence of the user's expressions by deciphering the intricate facial coordinates and landmarks.

To accomplish this, the project relies on the robust capabilities of the Numpy library. Numpy proves instrumental in transforming the raw input data into structured arrays. These arrays encapsulate the precise facial coordinates and landmarks, serving as the foundation for the subsequent phases of the project.

In essence, this pivotal step facilitates the conversion of real-world expressions into structured digital representations, setting the stage for model training and, ultimately, the conversion of emotions into expressive emojis. The accurate storage of these coordinates ensures the project's ability to discern and convey the subtle nuances of human emotion.

5. TRAINING THE MODEL

The model embarks on a crucial phase where it learns to recognize and interpret the user's expressions. It leverages the user-provided input data, encompassing both facial and hand landmarks/coordinates. Over a span of 70 training epochs, the model undergoes a focused learning process.

Notably, the model's training focuses on a single expression at a time, ensuring precision and accuracy. This streamlined approach allows the model to specialize in capturing the nuances of individual expressions. By training on a specific emotion in each iteration, the model is finely tuned to decode and mirror the diverse spectrum of human emotions.

6. RECOGNISING THE EXPRESSIONS

In the project's culminating phase, the OpenCV library takes center stage. It facilitates the live webcam display and engages in real-time expression

recognition. As users convey their facial and hand expressions, the system meticulously analyzes these dynamic movements.

The analysis hinges on a comparison between the user's expression coordinates and the stored landmarks. If a user's expressions closely align with the predefined landmarks, the system springs into action, displaying the corresponding emoji. This responsive approach allows the system to recognize and replicate a spectrum of emotions, effectively conveying the user's intent through a dynamic array of expressive emojis.

7. CONCLUSION

Throughout this project, our mission was to establish a seamless connection between human expressions and emojis, fostering a meaningful and efficient bridge between the two domains. Our journey encompassed diligent research, comprehensive data collection, and the creation of a robust preprocessing system.

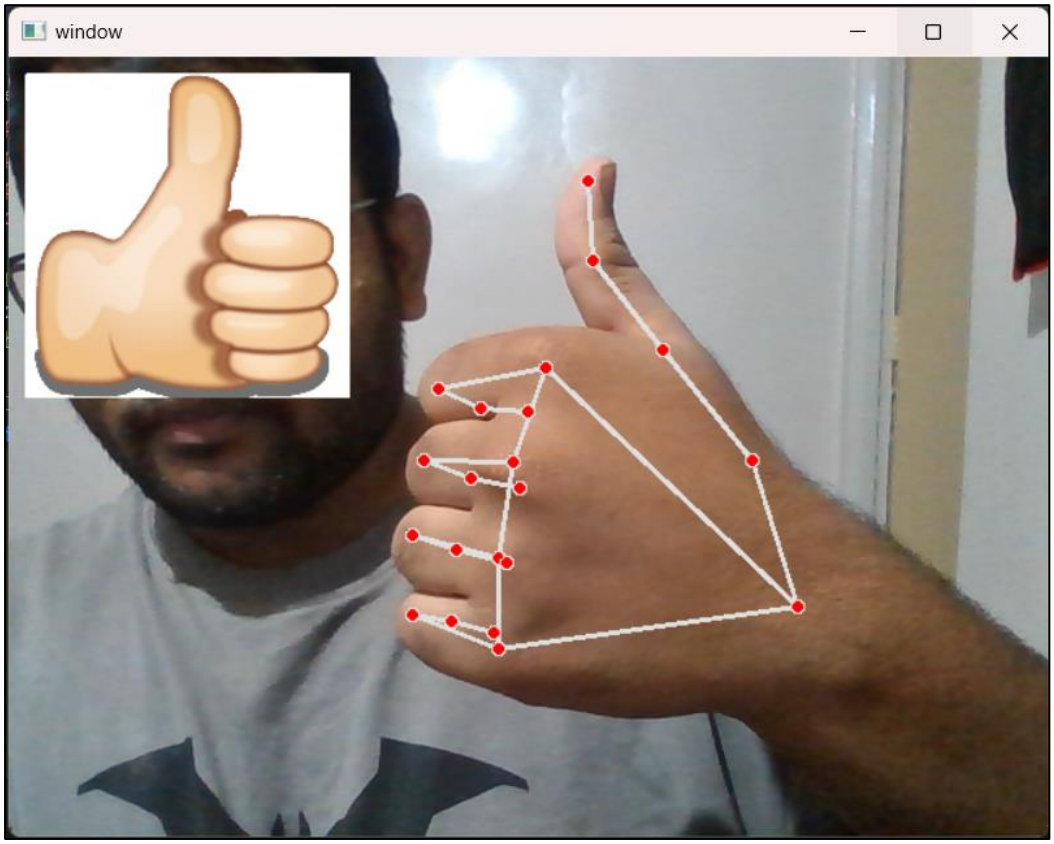
As we draw the curtains on this endeavor, we extend our sincere appreciation to our dedicated team, wise advisors, and valuable collaborators. We are equally

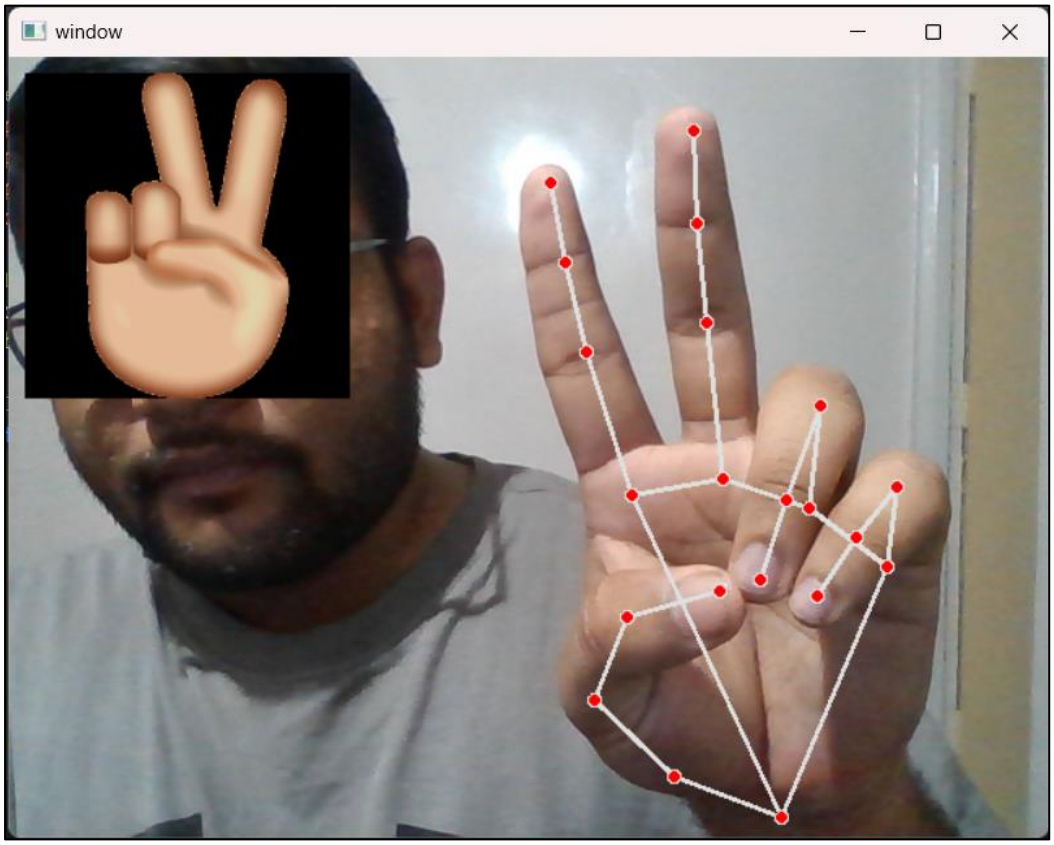
grateful for the invaluable feedback and insights generously shared by our users. This project stands as a testament to our

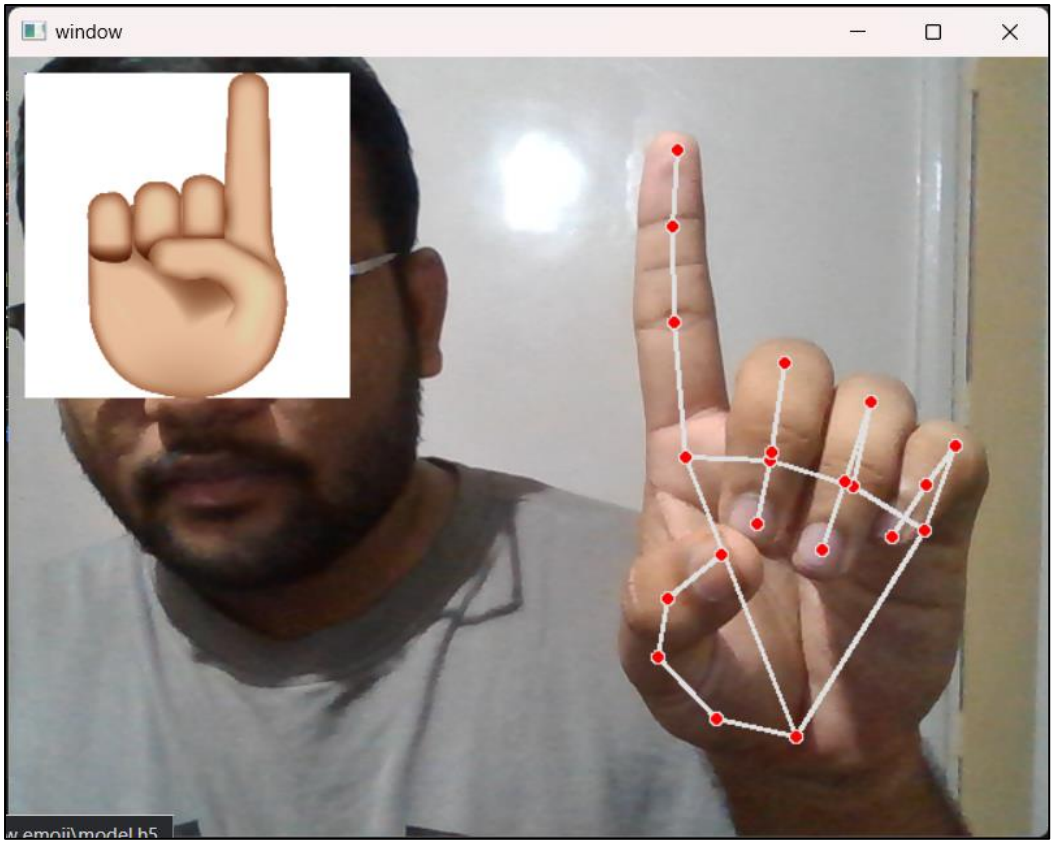
commitment to enhancing the human-computer interaction experience, celebrating the rich tapestry of human emotions, and providing a medium for expression that transcends digital boundaries.

Emojis Used

Output Screen:







References

[1] Emojis https://emojiisland.com/pages/free-download-emoji-icons-png

[2] Mediapipe: A Framework for Building Perception Pipelines. (n.d.). Retrieved from https://mediapipe.dev/

[3] OpenCV Library. (n.d.). Retrieved from https://opencv.org/

[4] Numpy Documentation. (n.d.). Retrieved from https://numpy.org/doc/stable/

[5] Keras Documentation. (n.d.). Retrieved from https://keras.io/guides/

[6] Python Software Foundation. Python Language Reference, version 3.8. (n.d.). Retrieved from https://docs.python.org/3/

[7] Emotion detection with Python. (n.d.). Retrieved from https://towardsdatascience.com/emotion-detection-with-python-1d447b193498

[8] Facial Expression Recognition with Keras. (n.d.). Retrieved from https://towardsdatascience.com/facial-expression-recognition-with-keras-96f11e9a6d41