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DEEP LEARNING BASED REAL-TIME SIGN LANGUAGE RECOGNITION SYSTEM BY USING HAND GESTURE REPRESENTATION

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Abstract: The Sign Language detection model is used to detect the signs of human hands and then detect the message by the camera in real-time to understand what that particular hand sign means. Another important aspect of the application is to perform translation based on the different structures of hand gestures. The different finger configurations and the hand's gesture on the body are the different expressions in sign language. The main aspect of the Sign language detection model has increased due to the rapid growth of dumb and hearing-impaired people. In this Project, we proposed a Sign language detection model by action detection powered by the LSTM layer to predict the sign language. The key point detection model is used to build a sequence of key points to the action detection model to decode sign language.

Index Terms **– Mp holistics, LSTM Neural network, deep learning, Action Detection, Sign language recognition.**

I. INTRODUCTION

Sign language detection is an AI technique that is used to illustrate human hand gestures. Hand gestures act as a medium of interaction for hard-hearing people. Different types of hand gestures of sign language are used by hard-hearing people and performed daily during communication Still when it comes to communication between the person who doesn't understand sign language both persons feel difficulties in communicating with each other. So, for the people living with disability this system sign language detection model is built with the action detection model to detect hand action and deliver the meaning to the user. It faces slight difficulties to implement as a system so we use MP holistic to extract the key points and preprocess the data. This system is built to capture the hand gesture in real-time and the Media pipe Holistic is used to detect the hand and the body poses with key point values. The LSTM is used to classify the sequential data, here LSTM is used to power the action detection. The key point values will be extracted and the data preprocessed. The prediction will be evaluated using the confusion matrix for accuracy. The system will be tested by capturing the hand sign moment in real time to check the translation of the sign language.

3.1 EXISTING SYSTEM

For gesture Recognition, data gloves for hands, motion capturing systems to capture movement have been used. Vision-based SLR systems have also been created before. Already developed Indian SLR system using deep learning is developed by MATLAB Author and They have worked with both the single and double handed gesture recognition. They used K-Nearest Neighbor Algorithm and Backpropagation Algorithm to train their system and achieved 96% accuracy.

3.2 PROPOSED SYSTEM

Sign language performers will be recorded real-time and that video will be taken as input by using OpenCV and also the data collected using MP holistic is used to detect the Face and hand gesture to extract key points. Then the extracted dataset will be trained to store sequences to put into video frame format. Here the key points will be created into a NumPy array as folders. The SLR system is tested and developed with the LSTM deep learning model. The model is built with three LSTM and dense layers to train the LSTM model. After creating the neural network, the SLR system is performed with OpenCV. Then the hand gestures are recognised then the output will be displayed as text.

3.3 ALGORITHM SPECIFICATION

The following four algorithm steps are used to create a sign language detection system are:

- Install and import dependencies.
- Collect key points.
- Collecting & preprocessing data.
- Testing and Training.

Install and import dependencies:

- Here we install and import dependencies
  - Tensorflow-gpu
  - MP holistics
  - ScikitLearn
  - OpenCV
  - Numpy
  - Pyplot

Collect key points:

- Here we detect Hand Gesture, Face Key Points to extract the data with key points will be detected with the MP holistic.

Collect & preprocess the data:

- Here the folders for data will be created using a numpy array to export the data and create separate labels for data.

Testing and Training:

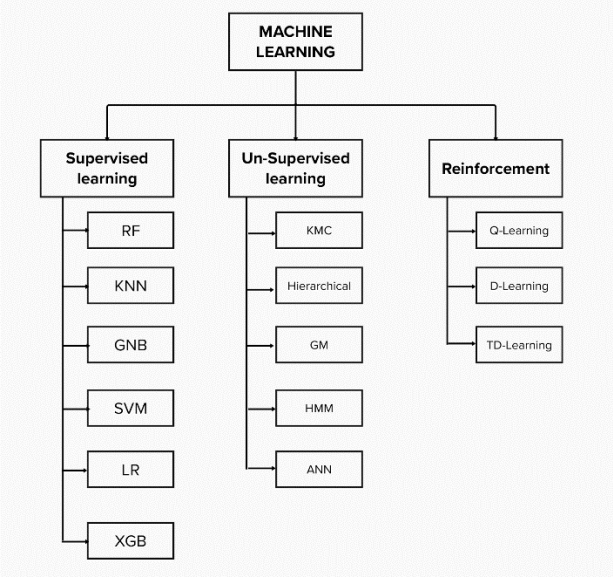
- Both TensorFlow and Keras will be used to build and train the model with a LSTM neural network and accuracy is defined for the model. Then, the model will be tested in real time.

3.1 MACHINE LEARNING

This design is built using a Machine learning algorithm. Machine learning is an AI branch which mainly focuses on the use of data and algorithms to make the system behave the way humans learn and gradually improve its delicacy. Its unique and intelligent gesture allows it to discover correlations and perceptivity that aren't readily apparent to the mortal eye, making abstractions from experience.

3.2 CLASSIFICATION

The main aspect of the classification algorithm is to identify the category of new observations on the basis of training data in deep learning models. when the model tries to predict the correct label for given input by a fully trained data model to find the probability of the data that will fall under one of the predetermined data model categories. The machine learning classification algorithm are:



3.3 LIBRARIES:

- OpenCV-python
- Tensorflow-gpu
- Matplotlib
- Keras
- Tensorflow
- Mediapipe Holistics
- Sklearn
- numpy

3.3.1 OPENCV:

- OpenCV is a library function in programming language for real-time computer vision. It also provides a lot of features including object detection, face recognition, and action detection. In this project we used OpenCV to capture the input in real time. Sign language performers will be recorded and that video will be taken as input by using OpenCV.

3.3.2 TENSORFLOW:

- TensorFlow is a software library for machine learning algorithms and AI algorithms developed by Google. It can be used to create Deep Learning models directly to simplify the process built on TensorFlow. In this project we used tensorflow-gpu.

3.3.3 MATPLOTLIB:

- Matplotlib is a software library for mathematical operations for creating static and interactive visualization in Python. Here we use Matplotlib to import dependencies NumPy, OS, time and Pyplot.

3.3.4 KERAS:

- Keras is a free neural network library that runs with TensorFlow. Keras is a library that provides a Python interface for Artificial Neural Network.

3.3.5 MEDIAPIPE HOLISTICS:

- The MediaPipe Holistic is used to combine components of the pose, face, and hand landmarks to create a complete landmarker for the human body.

3.3.6 SKLEARN:

- SKLEARN stands for Scikit-learn.It can implement deep learning models like regression tools, classification tools, clustering tools and statistical tools to analyze deep learning models.

3.3.7 NUMPY:

- NumPy is a library for Python. It is used to perform a variety of mathematical operations on arrays. Here we use numpy to create ndarray to process the data to access and manipulate the data.

3.4 REQUIREMENT SPECIFICATION

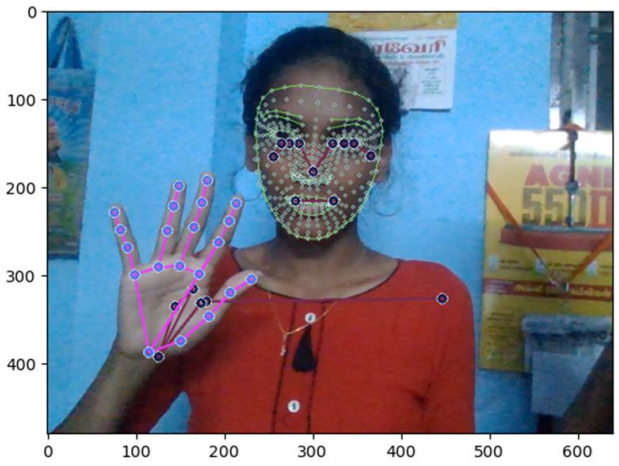
3.4.1 Hardware Requirements:

- **Camera:** 3MP
- **RAM:** 8GB and higher
- **Processor:** core i3 or higher

3.4.2 Software Requirements:

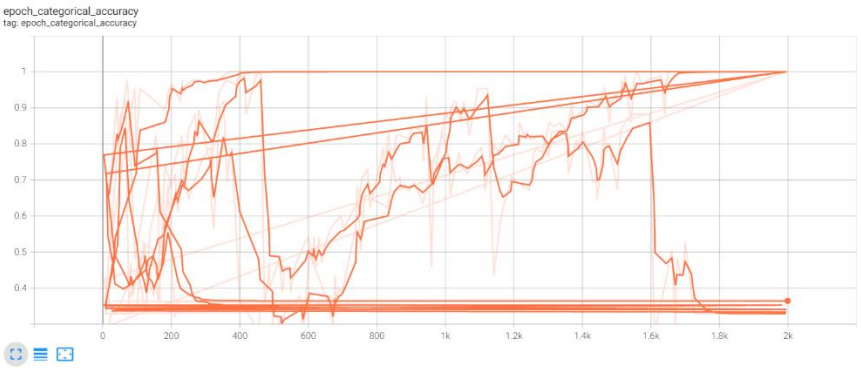
- **OS:** Windows 11 or higher
- **Program Language:** Python
- **Application:** Anaconda, Jupyter notebook
- **Libraries:**
  - OpenCV
  - TensorFlow
  - Matplotlib
  - MediaPipe

3.5 RESULT AND DISCUSSION:

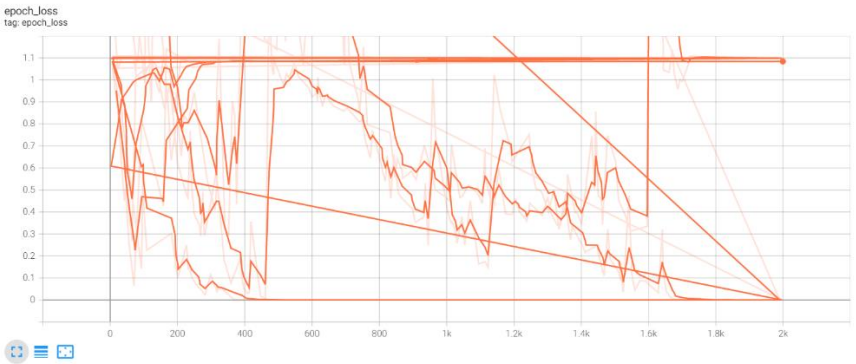


3.5.1 Extracting key points using MediaPipe holistic

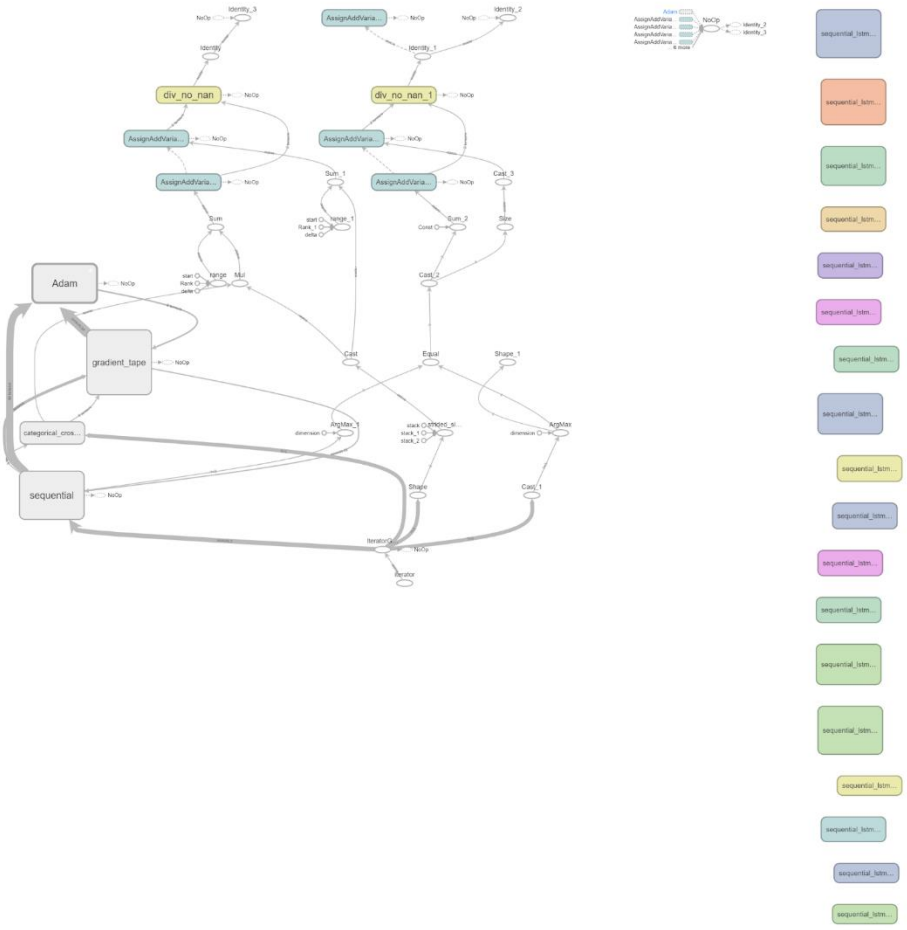
3.5.1 GRAPHS FOR RESULTS:



3.5.1.1 Epoch categorical accuracy for 2k

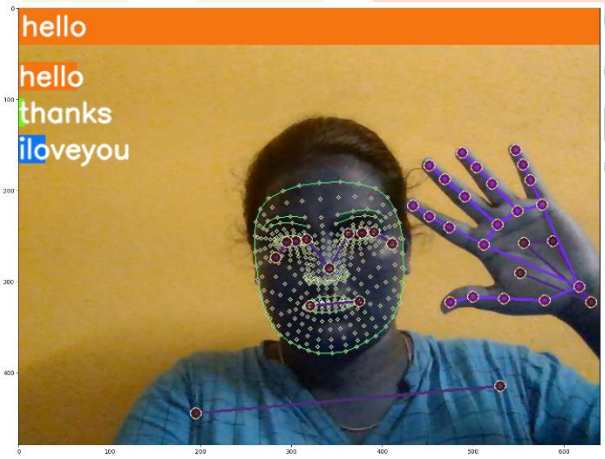


3.5.1.2 Evaluation using accuracy score of 2.000



3.5.1.3 Data flow graph built by TensorFlow.

4.1 RESULT:



4.1.1 Final output

4.2 FUTURE ENHANCEMENT:

- In future, this system we can add other sign languages as well.
- We can also expand and train the LSTM layer to recognize alphabets and symbols of hand gesture.
- This system can be enhanced to detect facial expressions. We can even display sentences instead of words that could be more readable.
- We can also add many number of training data that could give more accurate results.
- We can develop this system to completely help the deaf and hard hearing people to make them comfortable to communicate with normal people.

4.3 CONCLUSION:

The Sign Language Recognition System can recognize dynamic movements in video lively. There are various different types of sign language in each country. Many people from various countries use different sign languages that have differences in their grammar or how they portray each gesture. This SLR system can help people with hard hearing and the general public to understand their views better. It will benefit them during meetings, medical and legal appointments.

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