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Hand Gesture Recognition System UsingRandom Forest

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ABSTRACT:

Gesture recognition is an emerging topic in today's technologies. Handgesture recognition is an important area of research in computer vision and has various applications, including human-computer interaction, sign language recognition, and gaming. In this study, we propose a hand gesture recognition system using the random forest algorithm. The system first extracts hand features, such as palm centroid and finger length, from input images. Then, the random forest classifier is trained on a dataset of hand gestures to recognize different handgestures. The main focus of this is to recognize the gestures given by the people with the help of various algorithms likeRandom Forest, CNN, etc. Machine Learning is used to test the real time scenarios without any human intervention and helps to identify the trends and patterns easily. Generally for training an object we uses CNN (convolution neural network) for simple training and high accuracy but here we involved Random forest algorithm to decrease the execution time.

Key Words: Gesture; Hand Detection; Hand Recognition; Random Forest; LDP.

INTRODUCTION

Random Forest is a popular machinelearning algorithm that is commonly used for classification and regression tasks. It is an ensemble learning method that builds a collection of decision trees and combines their outputs to make a final prediction.Random Forest is known for its ability to handle large datasets with high- dimensional features and provide accurate results. In this context, Hand gesture recognition using random forest is a technique that uses a dataset of hand gesture images to train a random forestmodel to recognize and classify different hand gestures in real-time. The trained model can be used to recognize andinterpret the hand gestures performed by users and provide appropriate responses.This technique has various applications such as virtual reality gaming, sign language interpretation, and gesture-based control of robots.

EXISTING METHOD

In the existing system the Hand gesturerecognition is done using the Image Processing technique. They used the image segmentation method which makes to divide the image into multiple parts. This is typically used to identify the objects or relevant information in the digital images. The image is applied to the segmentation after the grey scale conversion and edge detection. A pixel colour in an image is a combination of three colours Red, Green, and Blue (RGB). The grey scale conversion is a methodology whichconverts the RGB image into the grayscale image. In the edge detection boundaries of object within an image is found through Canny Edge detection is a technique used

to extract the useful structural information from different objects.

After the segmentation the feature extraction and comparison is done. In the existing system techniques like K-means clustering, Lidar and vision based, Video streaming, and used Matlab for Processing, python language also used for implementing a CNN model, finally theoutput is displayed on the Screen. As the MATLAB code and CNN Model increase the complexity, High computational time compared to other trending techniques

PROPOSED METHOD

In this model the tasks can be divided into two parts firstly database for a Hand gestures are collected we are using our own created dataset and the other is develop and design a Random Forest Model for Hand gesture recognition. The collected data set is given as an input to the proposed Random Forest Model for training, validation and testing. Once the Random Forest model is trained, it is ready to be used for classifying new images which were not part of the collected dataset.

Figure Sample Images from Dataset

The implementation of the classification algorithm for the Hand gesture recognition task Combined with pre-processing and localization steps from previous works, theproposed method for Hand gesture recognition using Random Forest. The proposed classification solution is implemented using the Tensor Flow framework. The important aspects of the project are to train the dataset and extract the features of an image.

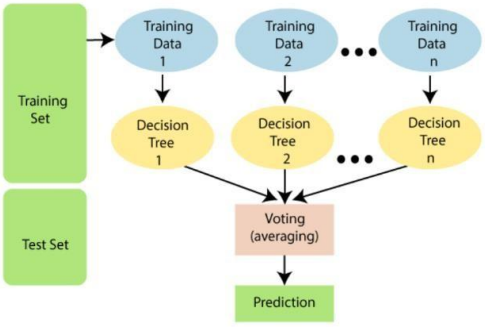

Figure Working of Random Forest

A system to detect and recognize Hand Gestures should be able to work in two modes; the training mode in which a database can be built by collecting a set of Hand Gesture that mapped to specific class as a label for

training and validation, and a prediction mode in which the system can recognize a Hand Gesture which has not been seen before by the model.

WORKING

Hand gesture recognition using Random Forest is a machine learning-based approach that involves training a Random Forest classifier to recognize different hand gestures from input image or video data. Here's a general overview of how it works.

In Data Collection a labelled dataset of hand gesture images or video clips is collected, where each gesture is associated with a corresponding label or class. In the Feature Extraction phase Relevant features or characteristics of hand gestures are extracted from the collected dataset.

Local Derivative Pattern (LDP) is a texture-based feature extraction technique that can be used in hand gesture recognition systems with Random Forest classifiers. LDP captures the local texture variations in an image, which can be indicative of different hand gesture patterns.

In Training Phase the Random Forest classifier is trained using the extracted features and their associated labels. During the training phase, the classifier learns to map the extracted features to the correct gesture labels based on the patterns it observes in the training data.

In Feature selection, techniques may be employed to identify the most informative features for hand gesture recognition. In Testing and Evaluation the trained Random Forest classifier is tested on a separate dataset that was not used during training to evaluate its performance. The accuracy, precision, recall, and F1 score are some common evaluation metrics used to assess the performance of the classifier.

Once the Random Forest classifier is trained and evaluated, it can be used to predict the hand gesture label for new, unseen input data. The extracted features from the input data are fed into the trained classifier, which then predicts the corresponding hand gesture label based on the learned patterns.

RESULTS

The Performance of a Random Forest based hand gesture recognition is evaluated based on various metrics such as precision, recall, F1 score, accuracy, and mean average precision (mAP). These metrics provide a quantitative measure of the system's performance, indicating how well it can detect Hand Gestures and how many false detections it produces.

This Random Forest based hand gesture recognition have shown great promise in accurately recognising hand gestures from images with in less time when compared to other popular methods. However, further research is needed to explore the optimal architecture and preprocessing techniques for achieving even higher levels of accuracy and robustness.

We can find that the system is trained in less time when compared to the other models, which is a great advantage for models like this which require less computational resourses.

The time required for reading the training data and training is as followed.

```
Use /tmp/tmp7l4ppude as temporary training directory
Reading training dataset...
Training dataset read in 0:00:10.628965. Found 16000 examples.
Training model...
Model trained in 0:00:44.059478
Compiling model...
```

Figure: Time taken for Training.

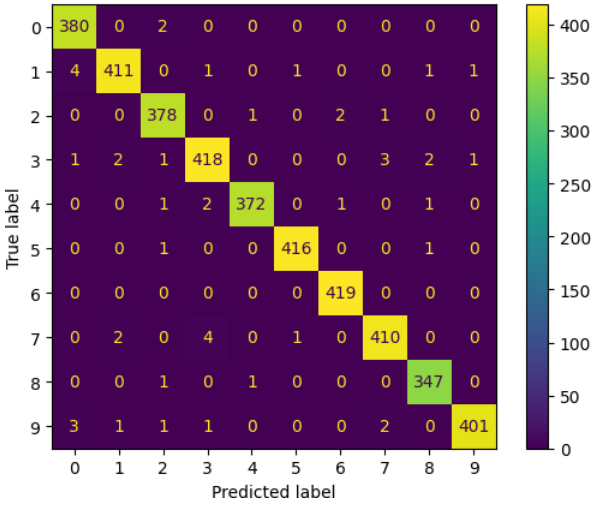

Figure: Confusion Matrix after testing

The confusion matrix represents the countsof predicted and actual values.

	precision	recall	f1-score	support
07_ok	0.99	0.99	0.99	382
05_thumb	0.98	0.98	0.98	419
10_down	0.99	1.00	1.00	382
02_l	0.97	0.99	0.98	428
09_c	0.99	0.98	0.98	377
04_fist_moved	0.99	0.99	0.99	418
03_fist	0.98	0.98	0.98	419
08_palm_moved	0.98	1.00	0.99	417
01_palm	0.99	0.98	0.99	349
06_index	0.99	0.97	0.98	409
accuracy			0.99	4000
macro avg	0.99	0.99	0.99	4000
weighted avg	0.99	0.99	0.99	4000

Figure: Classification Report

CONCLUSION

Random Forest can be a viable choice for hand gesture recognition projects depending on the specific requirements and characteristics of the data. It offers simplicity, interpretability, robustness to noise, and the

ability to handle small datasets and limited computational resources. Random Forest allows for manual feature engineering and ensembles of decision trees, which can lead to better generalization performance. However, it's important to carefully consider the trade- offs between different machine learning algorithms, including the advantages and limitations of Random Forest, and compare them with other options such as Convolutional Neural Networks (CNNs),based on the specific needs of the project. Factors such as the size of the dataset, the availability of computational resources, theinterpretability requirements, and the desired accuracy levels should all be taken into consideration when choosing the appropriate algorithm for a hand gesture recognition project. Thorough experimentation, evaluation, and validation of the chosen approach are crucial for achieving accurate and reliablehand gesture recognition results.

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