**Web Content Checklist**

This is a suggested format; well-organized reports in a different format will not be penalized.

1. Begin with an Extended Abstract that lists:

a. The project title

~~Hand in the Dark: Standardized Hand Gesture Recognition~~

b. The name of each project member

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c. At least one contact email address

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d. The name of the course and university

~~EECS 349: Machine Learning~~

~~Northwestern University~~

e. A 3-4 paragraph synopsis of what this work is about

i. motivate the problem: (what problem are you trying to solve and why should we care?)

Motivation

Gesture recognition is to interpret human motion after capturing the image. In this project, the input is a hand gesture picture, and the output is type of gesture as pre-defined in the dataset. This task is meaningful and desirable for its wide range of applications, including various commands, UI’s and communication programs.

ii. describe your solution in high level terms (what of learner(s) did you use, what types of features did you use)

Solution

In this project, we focus on gesture recognition of standardised pictures, i.e. how to take standardised hand gesture pictures, and how to classify them. We preprocess the pictures to detect the hands in them, crop the hands and save them as gray-scaled images of the same size, and the pixels outside of the contour blackened.

The extracted feature from the gesture images is the pictures encoded as lists of pixels. The feature will first be turned to binary , meaning that all non-black pixels will be coloured black. Then, the features will be sent to the 2-Nearest Neighbour classifier we write.

iii. describe how you tested and trained it (what your dataset was, how you measured success)

To create a dataset for the experiment, we use public HAAR cascade xml file to find the general location of a hand in an image, and around the general location we use the Canny edge detector in OpenCV to find the accurate contour of the hand. Each picture is labeled with a gesture ID, which is also what the algorithm needs to predict. A gray-scaled, 100x100 image is created around the contour of the hand, with the pixels outside of the contour blackened, as shown below

我是图片

F.g. 1: Data Preprocessing

With a dataset of 3130 processed pictures of 8 gestures from 7 people, we implemented 2-nearest neighbours to match the pixels: We subtract two image matrices and square the difference, find the picture that has the least difference with the input image, and return the gesture type of this picture as the predicted gesture type for the input.

To train the dataset, our code first reads directories’ names as a list of categories, read each picture as a list of pixels, and then label the type of each picture respectively. To test our classifier, we use cross validation across different people. Then, our function predicts the gesture type for testing set, validates it, and records the precision in a csv file.

iv. Describe the key results (how well your solution performed in no more than a paragraph, along with your key findings, e.g. the most important features for the task)

The result is improved as we diversifies the training set and increase the number of people from whom the gestures pictures are taken.

We first test several values for k-NN and get our best result at k=2.

The classifier can be improved using binary input, with an increase of accuracy from 0.630 to **0.844**, which is our best and final result.

We think k-NN would be a good classifier due to the nature of our dataset:

我是图表

F.g. 2: Justification of k-NN

This is proven correct as we test several other classifier using Weka, using 66% of the total dataset as training set and the rest as testing set. The results are shown as below:

我是表格

You can find our complete report below:

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f. At least one picture or graph that illustrates your work, with a caption explaining what the figure shows and its significance.

Our best

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