CSC 425 Artificial Intelligence Term Project
Facial Emotion Recognition from Big Data of Facial Expressions

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Background

Non-verbal communication plays an important role in developing intelligent systems that can exhibit better interactions with humans by closely emulating human-human communications. Human body gestures, postures, and facial expressions are used as non-verbal communication mediums to develop such intelligent systems in the context of user interactions with these systems for analyzing and enhancing the user experience. Amongst these modalities, facial expression is the most common due to its cost-effectiveness and high reliability, amongst other advantages. In the recent past, researchers in the field of HumanComputer Interaction (HCI) have developed intelligent methodologies to effectively recognize emotions conveyed by human facial expressions that have been implemented in real-time systems for a variety of applications, such as video gaming, machine vision, pain assessment, psychology, behavioral analysis, affect-aware computing, and clinical diagnosis [1-3]. As a result, modern HCI systems can easily "understand" the emotional expressions of humans and perform different tasks to enhance the user experience [1]. In this assignment, you are going to further investigate the same by developing a machine learning approach that can recognize various emotional states of users from facial expressions in the context of multimodal forms of user interactions.

Dataset of the prototype project

The dataset to be used for this assignment is available at this link - https://www.kaggle.com/murugappanm/facial-emotion-recognition-dataset. You can find detailed dataset information from this linked page. After downloading the dataset, unzip the folder. The data that you will be using for this project is present in the file with filename "normalizedData-collectedData-sorted.csv". In the dataset, 0 refers to angry, 1 refers to disgust, 2 refers to fear, 3 refers to sad, 4 refers to happy, and 5 refers to surprise for the emotion attribute (last column in this .csv file).

Objective and Requirements

The objective of this assignment is to develop and implement a decision tree (and other machine learning approaches) on a dataset of multimodal facial expressions to detect the six basic emotional states - happiness, sadness, anger, fear, disgust, and surprise. You are required to use Python and its libraries (such as Scikit-learn) to develop and implement the same.

In this project a project prototype is provided. The objective of this prototype is to develop and implement the decision tree algorithm on the dataset of facial emotion to identify different emotions. There are six types of facial emotions, i.e., angry, disgust, fear, sad, happy, and surprise. Based on the provided prototype, you are expected to understand this prototype and contribute more with the project. For example, you can collect your own dataset to test the performance of the Decision Tree algorithm. Or you may try other machine learning algorithms and then compare the results with the results generated by the prototype. Or you can apply this Decision Tree algorithm to solve other similar tasks.

Note that,

● If you decided to use other machine learning algorithms to solve this problem, then you have to select at least two machine learning algorithms in addition to the decision tree algorithm provided in the prototype. You may use other machine learning algorithm that covered in our lecture or their variants. Some other machine learning algorithms may be SVM classifier, Random Forest, Neural Network, Linear Discriminant Analysis, Quadratic Discriminant Analysis, and Naïve Bayes . Click on these respective links to learn how to implement these respective machine learning algorithms in Python using Scikit-learn.

● If you decided to use collect your own dataset to verify the effectiveness of the provided datasets and machine learning model, then you have to collect at least 30 facial emotion images for different emotions. You may also need to perform preprocessing steps on the collected images if you want to train your model with the provided dataset. In another word, your image should be consistent with the public provided dataset.

● You can choose any programming language you like to complete this term project, however, Python and its libraries, such as Numpy, matplotlib, and Scikit-learn, are highly recommend.

Deliverables

1. At the end of the semester, you will have 15 minutes to present your project. – **100 points**
2. Turn in your project report as described below – **400 points**

A report which must include the following information:

a. An introduction Section, including (*20 points*)
   i. Your group information;
   ii. Role and role description in the team;
   iii. A brief sentence of your achievements in this project?
b. Project description Section (*340 points*)
   i. Project Introduction Paragraph (*50 points*)
   ii. Project Dataset Paragraph (50 *points*)
   iii. Project Methodology (120 *points*)

● Develop a flowchart showing the working of all the steps of your program. Explain the flowchart in a step-by-step manner.
● Present and discuss the pseudocode of your program.

iv. Project Result presentation *(120 points)*

● Compute the performance accuracy of your project for the following train to test ratios: (i) training data: 60% and test data: 40%, (ii) training data: 75% and test data: 25%, (iii) training data: 80% and test data: 20%, (iv) training data: 85% and test data: 15%.
● Record the performance of your project for all the four different training to test ratios above by capturing the screenshots that show the overall performance accuracies for each of these ratios. Represent the variations in performance accuracies for all the four different training to test ratios listed above in the form of a plot. Note that plots should be

made by python code or other software.

● If you use the decision tree related machine learning algorithms, then you need to develop and visualize the decision tree that you developed for this classification task and calculate the total number of nodes and leaf nodes.

c. Conclusion or summary paragraph. (*40 points*)

3. Turn in your source code as one zip file to corresponding Canvas drobox. – **100 points**

4. You're encouraged to participate in the NKU Celebration with your project poster. Turn in your project poster if you attended the NKU Celebration activity. – **Extra 100 bonus points**.

References

1. Maruthapillai V, Murugappan M. Optimal geometrical set for automated marker placement to virtualized real-time facial emotions. PLoS One. 2016;11(2):e0149003.
2. Mehta D, Siddiqui M, Javaid A. Facial emotion recognition: A survey and real-world user experiences in mixed reality. Sensors (Basel). 2018;18(2):416.
3. Moolchandani M, Dwivedi S, Nigam S, Gupta K. A survey on: Facial Emotion Recognition and Classification. In: 2021 5th International Conference on Computing Methodologies and Communication (ICCMC). IEEE; 2021. p. 1677–86.