UNIVERSITI TEKNOLOGI MARA

MODIFIED SPECTRAL CLUSTERING ALGORITHM FOR SEMI-SUPERVISED FACE ANNOTATION MODELING

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ABSTRACT

Recent advancements in facial recognition have impacted security, healthcare, and identity verification, with face annotation — labeling facial features for training datasets—being crucial. However, traditional annotation is time-consuming and labor-intensive, making sufficient accurately labeled data hard to obtain. This research addresses this via semi-supervised learning, using semi-supervised clustering to expand datasets with limited labeled samples. A key issue in spectral clustering is fixed similarity matrices, which struggle with high-dimensional facial data complexities, non-linear relationships, and noise, leading to suboptimal results. To improve accuracy, an optimized similarity matrix was developed. It also integrated MustLink (ML) and Cannot-Link (CL) constraints, generated efficiently via the Label Propagation Algorithm (LPA) enhanced by combining Share Nearest Neighbour (SNN) and Radial Basis Function (RBF). Objectives included enhancing LPA accuracy, developing robust constraintbased clustering, and evaluating performance. The research streamlines annotation, reduces manual work, boosts facial recognition performance (98.97% purity), and contributes to computer vision and AI with efficient large-scale face annotation solutions, developing two models.

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CHAPTER 1
INTRODUCTION

This chapter presents the foundational context and justification for the research. It offers a comprehensive overview of semi-supervised face annotation, followed by highlighting the problem statement that led to the study. Then, this chapter continues with the aim and objectives, before stating significance of the study. Lastly, it ends with a summary of this chapter.

1.1 Background of study

In recent years, facial recognition technology has achieved significant advancements across multiple sectors, serving a crucial function in areas such as security, payment authentication, identity verification, transportation, healthcare, and beyond (Gupta et al., 2023). The key step in face recognition technology is to use a large amount of annotated facial data to train the model. As the use of smartphones and the internet continues to expand, there is an exponential increase in the availability of facial images and videos, which provides a vast source of potential data for training these models. However, obtaining a large number of labeled facial images still faces difficulties (Yang et al., 2023). Face annotation is the process of adding labels or annotations to facial regions in an image or video. These labels of annotation can include information such as facial position, posture, facial expressions, gender, age, etc. Face annotation also provides crucial training data for research in the field of computer vision, which enables machine learning algorithms to recognize and understand faces in images (Kaur et al., 2024).

Facial annotation is one of the most important process required for training phase in face recognition systems, and it also contributes to the development of fields such as image understanding and artificial intelligence applications (Bansal et al., 2024). Annotation modelling emerges as a critical approach to address this challenge. It involves constructing computational frameworks that integrate semi-supervised learning and clustering algorithms to automate label propagation and enhance annotation efficiency. Unlike traditional methods that rely on exhaustive manual