FIT3161 / FIT3162

COMPUTER SCIENCE PROJECT

School of Information Technology
Monash University Malaysia

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Project Description

Title:
An optimized Real-Time Face Recognition in the Presence of Occluded Faces (Face Masks)

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Abstract

Face recognition (FR) has become a pivotal technology with wide-ranging applications due to its non-intrusive, human-analogous, and versatile nature. However, its effectiveness encounters challenges when transitioning from controlled laboratory conditions to real-world scenarios. Intra-class variations, such as illumination, occlusion, and expression, introduce significant changes in facial appearance, leading to compromised recognition accuracy. The advent of the Covid-19 pandemic has necessitated the widespread use of face masks, posing a novel challenge to FR systems. The presence of face masks further limits facial information, exacerbating the difficulty for recognition systems to discriminate effectively. Hence, the development of a robust and real-time face recognition system capable of handling mask occlusion is crucial.

In this research project, the aim is to propose an innovative approach that leverages bio-inspired metaheuristic techniques for feature selection and deep learning methodologies to enhance the system's discrimination ability under adverse conditions. The proposed system will undergo rigorous evaluation and validation using extensive real-world datasets, encompassing various occlusion levels and environmental challenges. By harnessing the synergy of bio-inspired metaheuristics and deep learning, this project seeks to advance the field of face recognition technology, providing a practical and effective solution to address the challenges posed by masked faces in contemporary settings. The outcomes hold promise in significantly improving recognition accuracy and performance in real-time scenarios, offering valuable insights for future face recognition research and applications.

Keywords: Real-time face recognition, Occluded faces, feature selection, bio-inspired algorithms

1. Introduction and Background

In recent years, significant progress has been made in the field of facial recognition (FR) technology, thanks to the deep learning boom in computer vision. However, a persistent challenge remains in accurately recognizing faces with partial occlusion, which can be classified into two categories: facial accessories like masks, sunglasses, and scarves, and random objects in the facial area, such as glasses or cups. While facial recognition systems have achieved reasonable accuracy, handling face masks as an occlusion factor has not been thoroughly explored despite their widespread use during the COVID-19 pandemic.

The pandemic, spanning nearly four years since 2019, has made face masks a common preventive measure recommended by various organizations and governments. Despite vaccination efforts, face masks continue to be an essential aspect of public health. Nevertheless, psychologists have raised concerns about the difficulty in identifying individuals wearing masks, leading to potential challenges in human-to-human and human-to-machine interactions.

Addressing the issue of face recognition with occluded faces is becoming increasingly important for smooth and reliable FR in various contexts. This research aims to explore and develop solutions to improve FR accuracy when dealing with face masks. By overcoming the challenges of occlusion, we seek to enhance the performance of facial recognition systems, ensuring their effectiveness in practical applications and contributing to a seamless and efficient human-machine interaction experience.

2. Objectives

To achieve an optimized real-time face recognition system in the presence of occluded faces (face masks), the project aims to accomplish the following main objectives:

a) Develop a robust face recognition model that combines bio-inspired metaheuristic techniques and deep learning algorithms. This model will be trained using diverse datasets containing masked faces to ensure robustness and improved recognition accuracy.

b) Investigate and integrate state-of-the-art pose detection techniques into the system. By leveraging pose information, the system will enhance its ability to recognize individuals with occluded faces and improve overall recognition performance.

c) Implement bio-inspired metaheuristic algorithms to optimize feature selection. This step will enable the system to effectively identify and utilize discriminative facial information, even under challenging mask occlusion conditions.

d) Design and deploy a real-time framework that integrates the optimized face recognition model with the pose detection module. Evaluate the system's performance using comprehensive real-world datasets, assessing recognition accuracy, computational efficiency, and suitability for practical surveillance applications, such as deployment on drones or edge devices.

3. Project Overview / Motivation:

This project aims to develop an optimized real-time face recognition system to address the challenges of recognizing masked faces. By integrating bio-inspired metaheuristic techniques and deep learning algorithms, the system will enhance discrimination ability under mask occlusion conditions. The project's impact lies in improving face recognition accuracy for practical applications, such as surveillance and security. Real-world datasets will evaluate the system, and its feasibility for deployment on drones or edge devices will be explored. Ultimately, the project strives to advance face recognition technology and contribute valuable insights to the field of computer vision and artificial intelligence.

4. Scope of Technology (Python):

The project will utilize Python as the primary programming language for its versatility and extensive support in machine learning, deep learning, and computer vision. It will employ popular deep learning frameworks such as TensorFlow, Keras, and PyTorch for building and training neural networks. For image processing and computer vision tasks, the project will utilize libraries like OpenCV and Dlib. Python will also be used to implement bio-inspired metaheuristic algorithms for optimization. Real-time deployment on drones or edge devices will be considered, with a focus on optimizing model efficiency for resource-constrained environments.

5. Suggested Methodology:

The proposed methodology involves the following key steps:

Dataset Collection: Gather diverse datasets containing masked faces to train and evaluate the face recognition model. These datasets should represent real-world scenarios with varying levels of mask occlusion.

Bio-Inspired Metaheuristic Algorithms: Implement bio-inspired metaheuristic algorithms to optimize feature selection. These algorithms will help identify and extract discriminative facial information despite mask occlusion.

Deep Learning Model: Develop a deep learning-based face recognition model, utilizing convolutional neural networks (CNNs) to learn intricate facial features. Train the model on the collected datasets, incorporating the optimized features from the metaheuristic algorithms.

Pose Detection Integration: Integrate state-of-the-art pose detection techniques to augment the model's discrimination ability, especially for occluded faces.

Real-Time Framework: Design and deploy a real-time framework that seamlessly integrates the optimized face recognition model with the pose detection module.

Evaluation: Evaluate the system's performance using extensive real-world datasets, measuring recognition accuracy and computational efficiency.

6. Approaches

To start, the team has to decide the workload to each member based on the project objectives and scope as mentioned to complete the following:

a) Project management plan

b) Project design and prototype

c) Project progress report

d) Project proposal with literature review

e) Prototype development

f) Final report