Statement of Purpose

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Brief Introduction

As a research assistant at the Zhejiang University of Technology's City Science and Social Computing (CSSC) Lab, under the mentorship of Professors Guojiang Shen and Xiangjie Kong, I focus on developing algorithms designed to address practical challenges in areas such as traffic forecasting, recommendation systems, and gesture recognition. My contributions include developing a robust gesture recognition pipeline, which achieved a notable accuracy rate of 92.68%, and constructing a gesture recognition network that attained a 94.56% accuracy on the AUTSL dataset.

Research Experience

At the CSSC lab, I developed an in-air text-writing recognition module, part of an interactive federated active learning project. I integrated fingertip coordinates with a TMBA model using Google's Mediapipe, enhancing trajectory image processing and character prediction with 94.42% accuracy. This work contributed to the publication of "FedAWR: An Interactive Federated Active Learning Framework for Air Writing Recognition" in IEEE Transactions on Mobile Computing.

My interest in gesture recognition, particularly in the nuances of subtle gestures, was sparked by the complex and challenging nature of this field. Motivated by these, I focused my efforts on enhancing gesture recognition methods. This pursuit led to a project with the in-Vehicle Interaction Information System (IVIS). In this role, I engineered a sophisticated gesture recognition system that leveraged RGB cameras, significantly broadening its usability within the in-vehicle environment.

My study on RGB-based gesture recognition methods, in light of the IVIS's computational limitations, led to the adoption of Google's Mediapipe for hand coordinate estimation. This choice was pivotal due to its performance optimization and hardware acceleration capabilities. The need to classify a limited set of gestures for driver-IVIS interaction guided my exploration into back-propagation (BP) and dynamic time warping (DTW) methods, culminating in a lightweight pipeline with an impressive 92.68% accuracy in the demanding in-vehicle environment.

To evaluate the real-world impact of gesture interaction, I set up a driving simulation environment and developed a driver interaction interface supporting both touch and gesture-based interactions. The results were telling; gesture interaction enhanced driver performance by 65%, with a significant reduction in user workload.

The culmination of this research, "Impact of In-Air Gestures on In-Car Task's Driver Distraction", published in April 2023, marked my understanding in gesture recognition technology for automotive environments. However, during comparative experiments, I noticed a decline in recognition accuracy under certain conditions, like rapid gesture sequences or partial finger obstruction. This observation led me to develop an enhanced gesture recognition network based on DenseNet architecture, integrating a DSTformer model for depth estimation and a Tree-Structured Skeleton Image (TSSI) to maintain spatial hierarchy. The implementation of Global Long-Sequence Attention (GLA) mechanisms was a game-changer, allowing the network to focus on critical spatio-temporal details. This innovation resulted in the GLA-DenseNet network achieving top-tier performance, with accuracies of 82.35% on WLASL-100, 94.56% on AUTSL, and 98.87% on LSM, rivaling state-of-the-art methods.

For detailed insights into my publications and projects, please visit my portfolio.

The paper of "GLA-DenseNet: An Advanced Convolutional Approach for ISLR Leveraging 3D Pose Estimation and Attention Mechanisms", with me as the lead author, was a testament to my strides made in gesture recognition research. My journey at the CSSC lab has been a blend of challenge and innovation, driving me to push the boundaries of technology in HCI. It has set a solid foundation for my future endeavors in this exciting field.

Professional Experience

Transitioning from theoretical concepts to real-world applications, I had the opportunity to lead a team in the prestigious 7th National University Intelligent Transportation Competition. Our project's goal was to develop an advanced digital twin system designed to model and analyze traffic scenarios at crossroads. Faced with the inherent challenges of limited visibility and detection constraints, our team employed an innovative approach. We integrated data from surveillance cameras and radar systems, utilizing advanced techniques like longitude and latitude mapping and object pose estimation to enhance our system's accuracy. This integration of different data sources and technologies was highly effective, as evidenced by our system achieving an impressive 93% accuracy rate in pinpointing automobile locations at crossroads.

The victory in this competition opened the door to an enriching internship at SUPCON, a leader in intelligent systems. Here, I was part of the ambitious "New Mirror City" project, where I applied my expertise in AI and machine learning to improve urban traffic management. This experience was invaluable in understanding how advanced technology can be leveraged to enhance societal well-being.

STEM Outreach

My journey has been complemented by active engagement in various outreach initiatives. As a member of the teaching assistant team at College Shangxue Group, I mentored around 100 freshmen in C++ programming, creating detailed notes on essential concepts and helping students overcome coding challenges. This role also involved acting as a liaison between students and faculty, significantly enhancing the C++ curriculum based on student feedback. These experiences not only honed my mentoring skills but also led to lasting friendships. As President of the ZJUT Yixin CS Club, I organized computer repair events, encouraging members to use their technical skills for community service. I also led the coordination of an e-gaming contest on campus, securing sponsorships from Tencent and Zhejiang Media Group, which enhanced my organizational and communication abilities.

Future Work

In my future research, I am dedicated to advancing the capabilities of deep learning networks to comprehend human behaviors and extract additional information through video sequences. My objective is to improve the networks' long-term memory, alignment of spatial and temporal information, and estimation of additional information. A key component of my research involves using an attentional mechanism to improve the network's memory in order to better focus on significant spatio-temporal features of a semantic video. By doing so, the network can achieve higher recognition accuracy and become more robust under complex background scenarios. Then, the network is given an extra pretrained estimator to extract additional spatial information, like depth, to overcome the limitations of video inputs and solve the problem of obstructed postures. Lastly, translation models should be utilized to achieve better connections between texts and human gestures. I hope the enhanced network can assist more people with hearing impairments, leading to a more inclusive environment.