

Statement of Purpose

for Fall 2022 UIUC M.Eng. in Electrical and Computer Engineering

Road rage, a phenomenon in which drivers refuse to give in to each other and resort to irrational quarrels since they treat each other as objects instead of subjects, is prevalent in many countries, including Taiwan. Being one of the victims of this situation, I believe that more connections can be established between drivers and automobiles to create a friendlier and safer road environment. The experience triggered my passion for intelligent vehicles and propels me to step into the field of AI engineering, especially regarding Computer Vision (CV) and Natural Language Processing (NLP). To fulfill my dream of making driving more humanized, I am applying to the M.Eng. in ECE program at the University of Illinois at Urbana-Champaign (UIUC) because it provides me with an environment to solve social issues with a group of outstanding members.

During my undergraduate studies, I turned my expectations into action by participating in diverse courses. For instance, I implemented the “Land and Road Detection” project in the Robot Vision course. The project established my basic concept of how automobiles perceive the world. Nevertheless, it would become more difficult for autonomous vehicles to move in a variety of environments since streetscapes change significantly. Hence, I took the Machine Learning course to understand how recent technology solves the domain shift problem, and I learned that the Transfer Learning technique could effectively handle the situation by changing streetscapes into different styles. To further improve the performance of my Transfer Learning assignment, I combined semi-supervised learning and utilized PCA visualization to observe the latent space. My work earned recognition when it was selected as exemplary. The experience cultivated my ability to utilize CV to build practical applications, reinforcing my competence in the self-driving car industry.

To obtain a deeper understanding of advanced CV applications in intelligent automobiles, I took part in the Vision and Learning Lab led by Prof. Yu-Chiang Wang. After reading extensive information about hackers trying to attack face recognition systems, which would become an indispensable application in intelligent vehicles, I became determined to focus on Face Anti-Spoofing (FAS) as my research topic. Although existing FAS methods have achieved strong performance under the intra-domain testing scenarios, their performance would drop dramatically when transferred to a different target domain, such as unseen backgrounds or shooting devices. To address the

domain shift problem in FAS, I designed a disentanglement representation framework that disentangled facial liveness features and liveness-irrelevant features. The resulting liveness features exhibited sufficient domain-invariant properties and thus can be applied to perform domain-generalized FAS. My proposal significantly increased the spoofing attack detection rate from 65% to 85% on average under four cross-domain testing scenarios. The work was awarded 2nd Place in the Bachelor Thesis Award and submitted to AAAI for publication after further refinement.

As I learned more about the automobile industry, the smart conversational robot systems caught my eyes and triggered my aspiration to explore the world of NLP. Therefore, I also actively participated in the research of Question Answering (QA), under the guidance of Prof. Hung-Yi Lee, to lay my foundation in the field. My efforts paid off when I led my team to reproduce a state-of-the-art model in the ShARC dataset. In the next stage, I plan to research multi-user reading comprehension machines and obtain knowledge about Speech Processing from online courses, both of which are promising techniques in intelligent vehicles. The research outcome in FAS and QA shows my strong executive ability in AI research, from designing learning frameworks to conducting experiments for validation.

Other than devoting myself to academia, I gained industry experience and stayed abreast of industry expectations by participating in the industry-academia cooperation project on Fisheye Face Recognition, which was supervised by Prof. Homer H. Chen. Aside from working with the team to develop the Smart Face Recognition Access Control, I also improved the recognition rate from 98% to 100% successfully by developing a continuous image mechanism. To overcome the barriers posed by the COVID-19 pandemic, we proposed the concept of balanced facial feature matching and, based on it, designed a robust masked face recognition system. The matching has been balanced since it was performed on features extracted from corresponding facial regions, setting it apart from conventional face recognition methods which showed severely degraded performance for faces occluded by masks. Our work effectively strengthened the recognition ability for masked faces while maintaining remarkable performance for unmasked ones. The face verification accuracy was improved by 3.3% on average for three masked face datasets, which research outcome was accepted by ICCE. This project experience cultivated my ability to analyze global trends and propose novel ideas to solve real-world problems.

Thus far, I have achieved solid academic achievements and cultivated the indefatigable spirit of research. To further approach my goal to establish a road environment full of safety, I hope to pursue an advanced graduate study that enables me to develop extensive insights into AI engineering. In this regard, UIUC's M.Eng. in ECE program offers essential training for students to become experts in AI. For example, I am interested in the Introduction to Robotics and the Advanced Robotic Planning courses, which will build up my expertise in the field of Robotics through a better understanding of fundamental techniques and mathematical theories. In addition, I am enthusiastic about participating in the Master's Project supervised by Prof. Girish Chowdhary. In particular, his research on developing intelligent mobile robots capable of handling different tasks in outdoor environments strongly appeals to me. I look forward to integrating Machine Learning and Robot Vision to create humanized vehicles. Attending your program would prepare me for assuming positions in the Research and Development department in a related industry after graduation, such as Argo AI, Waymo, Tesla, etc.

UIUC's diversified courses and solid training will give me an in-depth understanding of AI engineering, cultivating my competitive edge when entering the workforce. I am confident that my persevering and creative personality will allow me to contribute to the diversity of UIUC and begin a successful career in my field of interest.