Statement of Purpose
Master of Science - Electrical and Computer Engineering / Software Engineering
Applicant: Lin-Hsi Tsao

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.S.-ECE program at Carnegie Mellon University (CMU) 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. To address the image domain shift problems in FAS, I designed a disentanglement representation framework that disentangled facial liveness features and liveness-irrelevant features. 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, 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 and future plans show 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 researched Masked Face Recognition and effectively achieved state-of-the-art performance, which research outcome was accepted by ICCE. Under the rigorous training from Prof. Chen, I not only gained experience in dealing with real-world issues but also developed a positive attitude to face stress and frustration.

When I first stepped into this field, my unfamiliarity with identifying and resolving the core problems has often resulted in harsh criticism from my supervisor. I was overwhelmed by stress and was afraid to take part in meetings. However, I soon realized that dodging problems would put me several steps behind my goals; therefore, I actively consulted the experience of senior peers and solicited guidance from the supervisor to address the issues that I encountered. Gradually, I turned the challenge into an opportunity for self-learning and advancement. Since then, I have pinpointed potential problems accurately and leveraged systematic and efficient approaches to tackling them. I was even recommended by my supervisor to deliver a speech about my research experience to undergraduates, encouraging them to foster a forward-looking mindset when performing research. This experience has armed me with the ability to turn stumbling stones into building blocks whenever I come across obstacles and strengthened my positive influence on others.

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, CMU's M.S.-ECE program offers essential training with distinguished faculty for students to become experts of AI. For example, Prof. Marios Savvides' research on integrating face detection, face recognition, and other CV techniques to develop humanized vehicle systems strongly appeal to me. His unique startup industry experience links to my experience in the industry-academia cooperation project and the Creativity and Entrepreneurship Program. In addition, I am interested in Prof. Ian R. Lane's research on the Intelligent Driver Assistive System, which fulfills my dream of creating humanized driving systems. 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.

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CMU'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 make contributions to CMU and begin a successful career in my field of interest.