Personal Statement

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Ever since my first Pentium 4 PC, I've been tinkering with computers and checking out all the fascinating software applications. This hobby inspired me to be a lifelong computer science enthusiast. However, my medical information studies help me discover the true promise of Computer Science. I learned that smart healthcare can drastically reduce the staff needed for patient surveillance and, more importantly, leverage AI to improve patient welfare by enabling real-time monitoring, reducing human error, and improving diagnostic accuracy. Motivated by this vision, I became the first student to pursue a double major program between Kaohsiung Medical University (KMU) and National Sun Yat-sen University (NSYSU) to integrate computer science with medical studies.

As a junior, I joined Professor Wen-Hsien He's AI Lab at KMU, where I designed a clinical medical module embedded with an Arduino-based sensor system to address pressure ulcer care. Using thermostats and triaxial accelerometers, I estimated heat flux and surface temperature distributions, applying the heat diffusion equation with the unscented Kalman filter for data analysis. Additionally, I integrated wound images with temperature and humidity signals using CNN and LSTM for multimodal learning, improving model accuracy by over 12% and overcoming problems of data sparseness and sensor data diversity. Through this experience, I understand that smart healthcare requires mastery of software and hardware skills and in-depth knowledge of biology and biomaterials. I learned to think beyond a medical application's perspective, exploring smart manufacturing during my senior year. At AU Optronics (AUO), I led a project to develop a mobile application for factory directors to improve decision-making during emergencies and enhance workflow efficiency, gaining expertise in real-time fault detection and more interest in combining hardware and software systems.

Gradually, as my knowledge about smart manufacturing grew, I recognized the value of domain knowledge in processing skills of different types of data. Hence, I joined Flow Inc., which focuses on automated industrial and geospatial data processing. I was responsible for building a data preprocessing pipeline in Python and integrating different data preprocessing modules into the AI platform of Flow, Inc. I reduced system time by 23% and improved data processing efficiency. I also built AWS EC2 machines to move some mature data processing services into it to scale our capacity, reinforcing my understanding of data workflow and cloud computing integration. Reflecting on my experiences with medical, industrial, and geospatial data, I learned that data quality and feature selection are key to machine learning, a realization that significantly influenced my master's thesis research in biomedical engineering at NYCU. I developed a machine-learning-based pre-diagnostic system for periprosthetic joint infection (PJI) for my master's thesis. When I worked with healthcare professionals, I encountered a recurring problem: healthcare workers spend considerable time recording data manually, which often leads to errors and delays that impede the training of machine learning models. These issues influenced the accuracy of diagnosis and highlighted the need for automation in smart healthcare, which inspired me to develop hardware-integrated products to enhance data quality and improve real-time monitoring and diagnosis.

To address these challenges, we must develop wearable or implantable medical chips compatible with the artificial joint prosthesis to allow the real-time monitoring of patients' physiological data, ensuring high-quality and timely information for model training and improving diagnostic accuracy. To improve the development of smart healthcare, I helped launch Anivance AI, one of the world's leading organ-on-a-chip startups and joined the team in R&D. I work to develop these highly sensitive biosensor devices, integrating electrodes into microfluidic systems to measure the electrochemical properties of biomarkers. Anivance AI also enables high-throughput, automated analysis, allowing for data collection with both efficient and scalable input. I aim to reduce environmental interference, enhance sensor stability and long-term accuracy in vivo and automate relevant diagnostic processes. Furthermore, I gained valuable experience in processing multi-omics data (i.e., genomics, proteomics, and metabolomics) and better understood the interplays across multiple biological levels of drug action.

My ultimate career goal is to research and develop a high-efficiency, low-power implantable medical chip based on GaN materials integrated with biocompatible materials such as titanium and parylene for encapsulation, which can stably work in the human body for a long time without triggering immunity or other adverse reactions. I will target the most essential biomarker, alpha-defensin, to keep low technical complexity and create a more stable system. The biomarker, a molecule strongly linked to periprosthetic joint infection, helps alert medical personnel when an issue arises so they can intervene. To do so, I intend to use microfluidic technology along with embedded electrodes in the microchannels, which will allow for electrochemical sensing as the binding reactions between alpha-defensin and specific antibodies will generate electrical signals that will quantify the concentration of the biomarker. Moreover, by incorporating surface plasmon resonance (SPR) technology, the system enables the development of an optical feedback mechanism that benefits detection based on molecular interactions. These two approaches complement each other, as electrochemical sensing needs external signal modifiers while SPR is a highly sensitive label-free tech. Therefore, they represent a multimodal detection method that operates well, providing effective and accurate detection of biomarker compounds in the microfluidic chip unit. As the project progresses, I plan to gradually expand the system to detect other important biomarkers, such as leukocyte esterase (LE) and synovial C-reactive protein (CRP), further enhancing the diagnostic capabilities of the system.

My past work has equipped me with the skills to process medical data and develop early-stage medical IoT products, but it also revealed some gaps in my knowledge of hardware design, signal processing, and Microelectromechanical Systems (MEMS). The MSc in Electronic Engineering with Management from King's College London fits this ambition to integrate hardware and software in the development of medical chips perfectly. The program's emphasis on the design and analysis of digital integrated circuits, fundamentals of digital signal processing and management skills gives me the perfect foundation for creating low-power, high-sensitivity medical chips for real-time monitoring. I aspire to work towards such smart healthcare solutions in the realm of AI-enabled diagnostic systems, bridging technology and medicine with KCL's hands-on research-based education, engagement with prominent scientific societies, and collaboration with healthcare and engineering leaders around the world.