**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, it wasn't until I was studying medical information in school that I discovered the true promise of Computer Science. I learned that smart healthcare can drastically reduce the staff needed for patient surveillance and, more importantly, allow the patients to be detected through artificial intelligence, which can vastly improve their welfare. By continuously leveraging AI to analyze real-time data, healthcare providers can make decisions more wisely, reduce human errors, and ultimately provide faster and more accurate diagnoses that revolutionize the quality of care. However, I can't help but notice that my resources were minimal at the time, given that my university is a pure medical University. Driven by this realization and my passion for applying computer science to healthcare, I became the first to pursue a double major program between two top-tier schools, Kaohsiung Medical University and National Sun Yat-sen University.

During my junior year, I was a research assistant in Professor Wen-Hsien He's AI Lab at Kaohsiung Medical University, where I designed a clinical medical module. This project involved embedding an Arduino-based temperature and humidity sensing module and a triaxial accelerometer into a medical mattress to probe its potential clinical use for pressure ulcer care. The research eventually achieved the goal of predicting the risk of pressure ulcers remotely and plans to eventually integrate this design concept into medical chips for use in clinical smart healthcare devices. We estimated the patient's surface temperature distribution using embedded thermostats and calculated heat flux and temperature distribution through the heat diffusion equation with finite difference methods and dual iteration of the unscented Kalman filter. Furthermore, we integrated temperature and humidity signals with wound images using CNN and LSTM for multimodal learning. This method not only improved the model accuracy by over 12% but also overcame problems of data sparseness and sensor data diversity. Through this experience, I understand that the development of smart healthcare is an ambitious goal. In particular, it requires not only mastery of software and hardware skills but also in-depth knowledge of biology and biomaterials.

As I continued accumulating experience in software and medical IoT, I gradually noticed that thinking and developing solely from a medical application's perspective may be too one-sided. Therefore, during my senior year, I became interested in smart manufacturing in the industry. Smart manufacturing's real-time monitoring and machine predictive maintenance are also applicable to the development of smart healthcare. As a start to my official work career, I led a key project in the smart manufacturing department of AU Optronics (AUO). The project focused on designing a mobile application to facilitate the factory director's decision-making during emergencies. In order to transform the data into useful information, we needed to converge panel machine data from the factory sensor and visualized data. We also needed to get into the factory to deploy our application and observe how to improve the workflow. This unforgettable journey improved my understanding of hardware real-time fault detection and smart manufacturing workflow, enriching domain knowledge to fulfill my long-term target of popularizing smart healthcare and turning it into reality.

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. Besides process optimization, I am also responsible for building AWS EC2 machines to move some mature data processing services into it to scale our capacity. This experience reinforced my understanding of data workflow and cloud computing integration.

Reflecting on my experiences in domain knowledge in medical, industrial, and geospatial data, I learned that data quality and feature selection are the key factors of machine learning. These recognitions also influence my research during my master's thesis 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 hindered my PJI research progress in smart healthcare solutions. This challenge revealed the urgency of automation by improving hardware in the smart healthcare field and thus inspired me to develop hardware-integrated products to raise the standard of data quality and provide real-time monitoring and diagnosis.

To sufficiently cope with these challenges, we must develop a wearable or implantable data-collecting device compatible with the artificial joint prosthesis. For example, medical chips would allow the real-time monitoring of patients' physiological information. This solution would reduce errors and guarantee that the data required for the model training is of high quality and has timeliness, thereby improving diagnostic accuracy. By integrating my experience in data analysis and machine learning along with the optimization of clinical signals and chip designs, I am convinced that I can drastically improve the development of smart healthcare and bring a variety of remarkable progress to the medical field.

One of my ultimate goals in my career 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 technical complexity as low as possible 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. This skill will allow for electrochemical sensing in that the binding reactions between alpha-defensin and specific antibodies will generate electrical signals that will quantify the concentration of the biomarker. The ability to conduct real-time monitoring of alpha-defensin levels with high sensitivity. Moreover, incorporating surface plasmon resonance (SPR) technology in 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 label-free technique with high sensitivity; therefore, combined, 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 vital biomarkers, such as leukocyte esterase (LE) and synovial C-reactive protein (CRP), further enhancing the diagnostic capabilities of the system. With that said, however, the most critical function of the chip is to monitor specific physiological indicators of patients in real-time, especially critical biomarkers in the synovial fluids, which are essential for assessing inflammation and infections. These biomarkers can effectively identify and target early complications in PJI, such as infection, loosening, or wearing. By continuously monitoring the data, the medical chip can integrate and process it to achieve real-time awareness of the patient's joint condition, triggering alerts when anomalies occur. It helps doctors intervene early and prevent serious complications.

To advance toward that goal, I helped launch Anivance AI, one of the world's leading organ-on-a-chip startups and joined the team in R&D. As part of a professional team; I work to develop these highly sensitive biosensor devices, where my efforts are primarily focused on the integration of electrodes into microfluidic systems to measure the electrochemical properties of biomarkers. In addition to improving detection sensitivity and specificity, this approach enables high-throughput, automated analysis, allowing for data collection with both efficient and scalable input. Based on the accuracy of microfluidic technology, I will reduce environmental interference, stability, and long-term accuracy of sensors in vivo and also create a more automated way of the relevant diagnostic processes through it. Furthermore, this role provides me valuable experience in processing multi-omics data (i.e., genomics, proteomics, and metabolomics) and helps me better understand the interplays across multiple biological levels of drug action. I believe this research will better prepare me to connect the concepts involved in medical chip development to the biological sciences, providing me with the fundamental knowledge necessary to tackle the stability and timing of data transmission. These initiatives will go a long way in pushing forward the frontiers of smart healthcare and lead to future innovations in PJI diagnosis and treatment and improving the quality of life for our patients.

My past work has equipped me with the skills to process medical data and develop early-stage medical IoT products. I am also conducting in-depth research in biochips to ensure my capabilities can perfectly meet the needs of smart healthcare fields. However, it also revealed some gaps in my computer science background, especially in hardware design, signal processing, and Semiconductor Processing. Although I excelled in software skills in IoT-based machine learning programs, I still need more hardware knowledge to create a complete solution in the medical field. This motivates me to apply for the University of Arizona's Electrical and Computer Engineering (ECE) program, which can help me acquire the necessary hardware expertise to close the gap between software and hardware, promoting intelligent healthcare technologies.

Graduate studies at UArizona's Electrical and Computer Engineering (ECE) program with a concentration in Biomedical Technologies will thus be a strategic step toward my long-term goals. The Hardware Design and Signal Processing course will help me narrow the divide between software and hardware. Classes like Digital VLSI Systems Design (ECE 507) and Microwave Engineering II: Active Circuit Design will help me learn the skills I need to design medical chips, including integration enhancement of chips, low-power design, high-frequency communication ICs and mixed-signal processing capabilities. Meanwhile, Digital Signal Processing (ECE 529) would supplement my skills in filtering and denoising and equip me with the knowledge of processing biological signals from medical sensors. Moreover, Design, Modeling and Simulation for High Technology Systems in Medicine (ECE 572) will improve my mindset of integrating medical devices and AI medical chips. Integrating the knowledge gained from these courses allows me to seamlessly combine software with hardware, driving significant innovation in smart healthcare solutions.

As a candidate in the Electrical and Computer Engineering program at UArizona, I will combine my experience in Biomedical Engineering and AI with a focus on smart healthcare technology. Including medical chips in every device enables real-time patient monitoring along with AI-powered diagnostic and prompt precognitive abilities. Pursuing graduate studies at UArizona will empower me to make substantial strides toward my career objectives. I look forward to participating in UArizona's program and becoming a significant presence in UArizona's community.