The inspiration which changed my life was not so much from college classes, but rather two books written by MIT professor, Norbert Wiener: ***Cybernetics*** and ***The Human Use of Human Beings***. Wiener equates human and machine activities based on ***feedback of information***, claiming that the two are fundamentally same as ***information-processing entities***. Wiener's piercing insight broadened my perspective of robotics to deeper understanding, with a conviction that humans and machines will seamlessly coexist and the distinction between the two become imperceptible in the future. Wiener's depiction of the future clarified my dream as a robotic researcher: ***contribution to the society of human-robot coexistence.*** This research objective pushed me into the field of robotics. Based on the abstract inspiration from Wiener's insight, I found my true responsibility as an engineer to be providing practical solution with the given tools for ultimate human-robot coexistence**.**

Today, there are numerous unsolved problems in the field of robotics to achieve human-robot coexistence. Specifically, most robots still have big difficulty moving around human-made environments. To fully integrate robots into the human society, I recognized that developing robots which can freely navigate around the human-made structures is one of the essential challenges that must be addressed.

Wheel-Based Robots which can Climb Stairs was my first practical contribution to human-robot coexistence during Naver LABS[1]internship program. Stairs are typical obstacles which restrict the activity area of wheel-based robots. Since most robots are mobilized by wheel, finding a simple and powerful solution for stair climb is imperative. During the project, we discovered that producing Angle-of-Attack (AOA) was crucial for successful stair climb. Rather than adding an additional actuation system, we developed a simple passive structure called ***Tusk®***, which facilitated AOA for each stair step. In extension to the novel structure ***Tusk®***, we developed a simple 2-by-2 wheel robot called ***Tuskbot***. Without the tradeoff between simplicity and functionality, ***Tuskbot*** successfully climbed each stair steps within a half-second, and ***Tusk®*** was patented as an assistive structure for stair climbing robots.

Pursuing universal usages of ***Tuskbot***, we recognized that the shapes of stairs are highly arbitrary in real-world environments. To deal with this inconsistency, we categorized stairs into two groups: stairs with large nose protrusion and without riser, and stairs with various height and depth. To overcome the first group of stairs, I suggested adding a track mechanism, which is only activated in stair climbing process. For the second group, I designed the ***Tusk®'s*** optimal shape that is generally applicable for various stair dimension. Two distinct robots were developed under my calculation: ***Tuskbot with Track Mechanism*** and ***Tuskbot with Length Adjustment Mechanism***. Both improved versions of ***Tuskbot*** successfully climbed each corresponding stair challenge, and the designs were accepted at ***2017 IROS Vancouver***. The project provided me not only practical skills for robot development, but also the insight that enhancing the robot's mobility through mechanical design is one of the ultimate key leading to human-robot coexistence. Moreover, I noticed the enormous scope of knowledge that robotics encompasses, making my next necessary goal to extend my limited knowledge of mechanical engineering to other core fields of robotics.

The opportunity was given when I quickly understood the inefficient nature of battery pack production, spot welding each Li-Ion batteries in series for high enough voltage. I designed a PCB embedded with Li-Ion battery cases along with additional functionality, such as voltage monitoring system of each battery cells and spark protection circuitry for safe charging. The experience of designing PCB bridged the knowledge of mechanical and electrical

[1] Research Division of the Korean IT Company NAVER

engineering, the two core disciplines of robotics. This eventually enrichened my perspective of robotics as an interdisciplinary field, ultimately providing a more profound and advanced understanding of robotics.

The project achievements would not have been possible without the fundamental skills acquired from university. Since robot was always my first interest, university courses were devoted to robotics. ‘Swing Robot Project’ in the ‘Design, Manufacturing Process and Laboratory Class’ was my most memorable project. My main role was to compute the optimal swing length and mass value. With my calculation, our team developed a robot which successfully swung up to 70 degrees without unstable perturbation, and was awarded the grand prize. Furthermore, I was the team leader at ‘Creative Engineering and Design Class’ project for Manual and Autonomous Robot development, awarding our team the first runner-up prize. As a team leader, experience of making appropriate decision without losing team integrity established my capability as a leader. Robotics is a highly interdisciplinary field, and working as a team is inevitable. Team projects stimulated my decision to be a pioneering leader in the field of human-robot coexistence, guiding group of skillful engineers to the ultimate success.

Wiener’s conceptual framework with practical skills learned from projects established the self-confidence to continue pursuing my research dream. There are still numerous challenges to seamlessly immerse robots into human society. To solve these problems for constructive human-robot coexistence, I have no doubt that my next decisive goal is conducting professional studies in graduate school. This strong ambition itself is my greatest motivation for graduate studies and I believe that MIT is the only institute to realize my dream for human-robot coexistence.

Based on the lesson from ***Tuskbot***, I strongly believe that mobility enhancement through mechanical design is one of the ultimate answers leading to human-robot coexistence. In this regard, Prof. Sangbae Kim’s research on locomotive robots will be the great place to achieve my research dream. His research on mobility enhancement through novel mechanical design, such as high torque electric actuator which enabled MIT Cheetah to run and jump, will offer me great skills for my research objective. I have no doubt that my mechanical design skills learned from ***Tuskbot***, will add to his research on mobility enhancement, hence leading to robots which can freely navigate around the human environments without difficulty.

Not only mechanical design, but development of a more sophisticated system is needed to cope with the enormous uncertainty inherent in the human environment. To overcome this challenge, I believe that implementation of autonomous driving system to robots is critical. This issue was elucidated from my personal experience with ***Tuskbot***, which the manual control of the entire driving system was the biggest limitation for real-world distribution. Therefore, Prof. John Leonard’s works on unknown environment navigations have strong implication for my future research. His research on autonomous navigation for mobile robots in unknown environment will be one of the greatest topics for my future research. Merging his autonomous driving research with my mechanical design skill will ultimately be a crucial step towards human-robot coexistence.

Finally, as robots start to become an integral part of the human society, the workspace of robots will inevitably overlap with the human workspace. Without the consideration of human-robot interaction, unavoidable discord between the two will occur. Therefore Prof. Neville Hogan’s research on human-robot interaction will mediate the two distinct entities, hence leading to a society with human-robot harmony.

MIT is famous for its inspiring faculty members, and the interdisciplinary curriculum provides the best environment to gain vital experience for a prospective engineer. I have no doubt that MIT’s graduate school will offer the most passionate and engaging environment to help me fulfill my dream for human-robot coexistence.