MAE 584: Internship

Internship Report: Exploring Advanced Automotive Technologies at Tesla

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Introduction

I had the privilege of undertaking an internship at Tesla as a service technician, delving into the heart of one of the most innovative companies in the automotive industry. This experience not only provided me with hands-on exposure to cutting-edge technologies but also enhanced my skills in problem-solving, critical thinking, and the practical application of theoretical knowledge gained during my pursuit of a Master's degree in robotics engineering.

Overview of Internship

My role as a service technician at Tesla exposed me to an extensive array of advanced technologies integrated into their vehicles. I had the opportunity to work with Vehicle Controllers, Car Computers, Autonomous Driving Systems, Battery and Battery Management Systems, Thermal Management Systems, Regenerative Braking, Electric Motor Design, Power Electronics, Electro-Mechanical Actuators, Sensors, and Advanced Chassis Design and Manufacturing Techniques.

Technical Exposure

Car Computer and Vehicle Controller

Car Computer and Vehicle Controllers are like the nervous system of the vehicle. The Vehicle controllers send and receive data to actuators or other leaf systems and carry the information from the sensors all around the vehicle to the Car Computer, where these signals are processed, and the required commands are sent to the relevant systems.

The Car Computer is a collection of multiple processors that control various Autonomous functions of the vehicle as well as provides signals to motors, battery management system, etc. The Autonomous Driving System is controlled by the Car Computer and has a redundant system that can take over the Autonomous functionality in case the primary computer fails.

With the innovative Drive-By-Wire and Steer-By-Wire system, the Car Computer analyzes the movement of the pedals and the steering wheel with micrometer precision and converts these to motor signals to drive the wheels or turn the wheels. This system also has multiple redundancies as it is critical to safety.

Autonomous Driving Systems

Understanding Tesla's autonomous driving technology was a cornerstone of my internship. I delved into the intricate details of how artificial intelligence and machine learning contribute to creating a driving experience that pushes the boundaries of conventional automotive capabilities. And delved deep into understanding how and why different types of sensors such as cameras, radar, and ultrasonic sensors are all integrated to produce a self-driving vehicle that needs almost no input from the driver. The most interesting part about this was the transition from using all the previously mentioned sensors to relying solely on cameras for the autonomous driving which stresses on the fact that so much can be done just by using a well-trained machine learning and artificial intelligence models backed by the vast amount of data generated from countless hours of real-world driving. This experience broadened my understanding of robotics and autonomous systems, aligning seamlessly with my academic background.

Battery and Battery Management Systems

Tesla's electric vehicles are renowned for their superior battery technology. During my internship, I had the opportunity to work with battery and battery management systems, gaining insights into the nuances of energy storage, charging, and the intricate management of power distribution. Studying how the battery enclosures are made and integrated within the vehicle gave a perspective on how the battery, being a structural part of the chassis, demands modification in the chassis design thereby improving the center of gravity which gives an improved handling characteristic and a heightened roll over protection. This hands-on experience complemented my academic studies in energy systems and advanced battery technology.

Thermal Management Systems and Regenerative Braking

The intricacies of thermal management and regenerative braking added another layer to my learning. I engaged with the thermal dynamics of electric vehicles, understanding how Tesla optimizes temperature control for both performance and efficiency. Exploring regenerative braking systems provided valuable insights into converting kinetic energy back into usable electric power, a concept deeply rooted in the principles of electronics and mechanical engineering.

Electric Motor Design and Power Electronics

Working on electric motor design and power electronics allowed me to bridge the gap between theory and practical application. I gained a deeper understanding of motor efficiency, control systems, and the role of power electronics in enhancing overall vehicle performance. This knowledge directly correlated with my academic focus on robotics engineering, where understanding the interplay between mechanical and electronic components is crucial.

Electro-Mechanical Actuators and Sensors

My internship involved hands-on experience with electro-mechanical actuators and a diverse array of sensors ranging from cameras and radar to various other environmental sensors, thermal sensors, motion and velocity sensors and position sensors. This exposure contributed

significantly to my understanding of the diverse range of sensors used in robotics and autonomous vehicles, reinforcing the importance of precise control mechanisms and sensor integration for creating intelligent and responsive systems.

Advanced Chassis Design and Manufacturing Techniques

Tesla's commitment to innovation extends to every aspect of vehicle design, including the chassis. Exploring advanced chassis design and manufacturing techniques gave me insights into structural engineering and materials science, offering a holistic perspective on the integration of mechanical components in futuristic automotive design. Not only is the chassis different from traditional vehicles because of the battery being a structural component, but the chassis is much different from traditional vehicles at a more fundamental level and uses manufacturing techniques different from conventional combustion engine vehicles. This makes Tesla vehicles very safe in case of an accident. Gaining this knowledge challenges me to think about structural designs in a more developed fashion which is transferable to any field of engineering that requires an innovative approach to designing its structural components.

Problem-Solving and Critical Thinking

As a service technician, my primary responsibility was diagnosing and identifying the root causes of customer-reported issues. This demanded a high level of problem-solving skills and critical thinking. I employed advanced automotive diagnosis tools, such as live CAN signal analyzers, and accessed vehicle system directories through shell command line interfaces. This experience not only refined my technical skills but also enhanced my ability to approach complex problems systematically—a skill set directly transferable to my academic endeavors.

Integration with Academic Background

My academic journey in robotics engineering provided a solid foundation for understanding the theoretical aspects of advanced technologies. The internship at Tesla acted as a bridge, connecting theoretical knowledge with practical application. Concepts learned in the

classroom, such as control systems, energy management, and materials science, came to life as I worked on Tesla's cutting-edge vehicles.

The exposure to autonomous driving systems aligned seamlessly with my studies in robotics, where I explored the intersection of artificial intelligence, machine learning, and robotics to create intelligent systems capable of autonomous decision-making. My experience with battery systems and thermal management complimented my coursework on energy systems, offering real-world insights into sustainable energy solutions.

The hands-on work with electric motor design, power electronics, and electro-mechanical actuators enriched my understanding of the intricate balance between mechanical and electronic components in robotic systems. This practical application of theoretical knowledge is invaluable as I progress in my academic journey.

Conclusion

In conclusion, my internship at Tesla was a transformative experience that not only expanded my technical skills but also provided a tangible link between my academic pursuits and real-world applications. The exposure to advanced automotive technologies, combined with the emphasis on problem-solving and critical thinking, has positioned me to contribute meaningfully to the field of robotics engineering.