Development of Modular Education Projects for High School Students in Mechatronic Automotive Engineering

Relevance to the Automotive and Autonomous Systems Industries:	Automotive engineering has changed significantly over the past several years due to ongoing electrification of powertrains. Hence the importance of mechatronics in automotive engineering is increasing, as is the need for more engineers entering this field. High quality educational modules are therefore needed to help inspire younger generations to pursue STEM disciplines and eventually mechatronics and automotive engineering.
Research Location:	Technische Universität Darmstadt Institute for Mechatronic Systems (IMS)
Homepage (Engl.):	http://www.ims.tu-darmstadt.de
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Project Description: May 22 - Jul 28, 2023 (10 weeks, 40 h/week)	The Institute for Mechatronic Systems (IMS) at Technische Universität Darmstadt offers internships annually to high school students to provide them with introductory insights into research. The goal of this NSF REU project is to design an educational module for these students, through which they can develop a basic understanding of current developments in the field of mechatronic automotive engineering. It is important that this module is interdisciplinary across all three fields of mechatronics (mechanical, electrical and software engineering); while being framed around the engineering product development process, from the design through the implementation of a prototype. **PHASE A** (Research Phase, 1 week): Investigate existing educational programs for children and adolescents with respect to mechatronics in automotive engineering. Develop an overview of potential concepts that include 3D CAD, 3D printing, and programming/controls. **PHASE B** (Preparation Phase, 2 weeks): Identify and define the final concept for the training module. Detail the work plan, including the complete bill of materials with all the components identified. Become familiar with the microcontrollers, software, and 3D printing tools that will be used in the training module. **PHASE C** (Practical Phase, 4 weeks): Source, price, and order the purchased components (e.g., chassis, electric motors, microcontroller), and fabricate the 3D printed components. Set up and test the design of the educational module. Program the microcontroller with visualization of data (e.g., serial communication instruments) and usage of controls (preferably PID). **PHASE D** (Testing Phase, 1 week): Test and validate that the training module functions as intended and adjust to address problems that might have emerged. **PHASE E** (Documentation Phase, 2 weeks): Write final report, document educational module, and deliver end-of-summer presentation on research performed.
Target publications:	• MDPI Vehicles
Necessary Skills/ Knowledge:	• 3D CAD, 3D printing
Desirable Skills/ Knowledge:	• Interest in STEM education, mechatronics, and automotive engineering
Additional Online Resource(s):	

NSF REU Students must have completed at least two semesters of engineering studies prior to the proposed summer research, and they must have at least one semester remaining before they can earn their BS in Engineering.