Exploring AI Hardware Applications in Experiential Learning Environments

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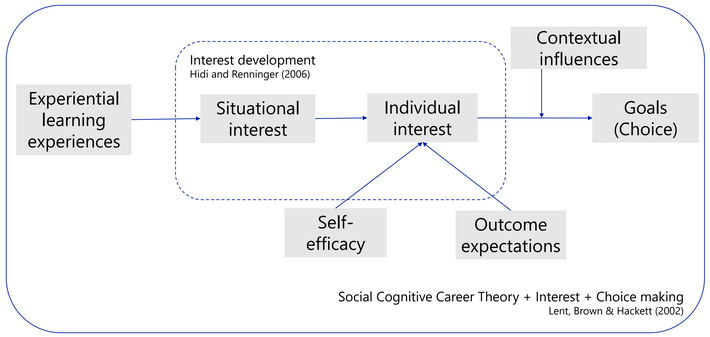
Background

- A matter of national security for the US is supporting the development of the semiconductor and microchip workforce to address the chip shortage and its negative consequences.
- Higher education institutions are establishing programs to train the necessary workforce and address the CHIPS and Science Act passed by US legislature in 2022.
- Students pursuing engineering degrees are more inclined to pursue software design rather than focus on hardware, primarily due to the perceived complexities and the time-consuming nature of electronic manufacturing processes.
- We have undertaken a project funded by the NSF IUSE program to explore the usability and feasibility of AI-focused hardware activities specifically for first-year undergraduate students across various engineering disciplines.
- We aim to demystify AI and expand conceptions of ML to cultivate situational interest in computer hardware design and support hardware engineering career choice.

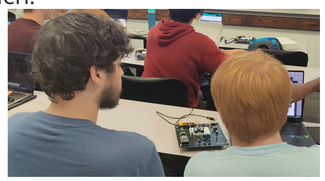
Theoretical Framework

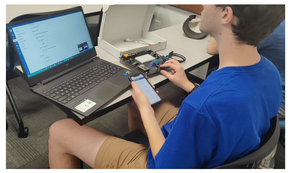


- We developed a conceptual framework to promote career choice by providing hands-on experiential learning. Career choice is supported by interest development, self-efficacy and outcome expectations.
- RQ: What are student's perceptions and practices in an undergraduate AI hardware curriculum?

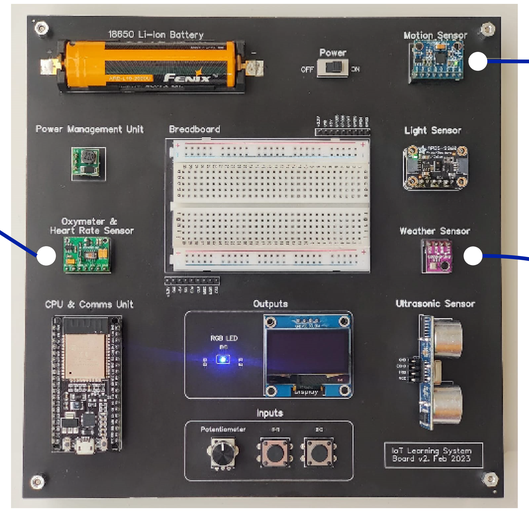
Implementation

- n=22 first-year engineering students are participating in a first implementation of the AI hardware curriculum (6 girls and 16 boys).
- The curriculum is integrated into an undergraduate course open to students in all engineering disciplines. No previous knowledge or skills are required.
- We scaffold each activity by offering a hands-on explanation of the hardware device. Afterward, we encourage them to collect data and understand the results.
- We provide the necessary codes and libraries for each activity.
- By the end of the semester, students will collaborate in groups to develop a real-world application using the AI hardware approach.



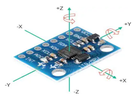


Artificial Intelligence IoT activities - Examples



AIoT learning board

Example 1: Predicting health conditions using the heart rate and oximeter sensor



Example 2: Predicting type of movement using the motion sensor

Example 3: Predicting rain chances using the temperature and humidity sensor

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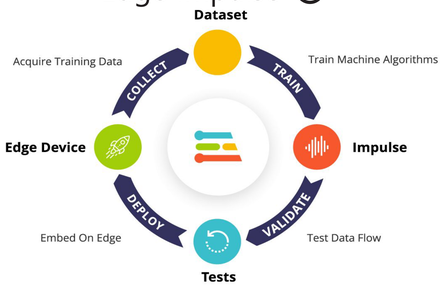
Edge Impulse ©



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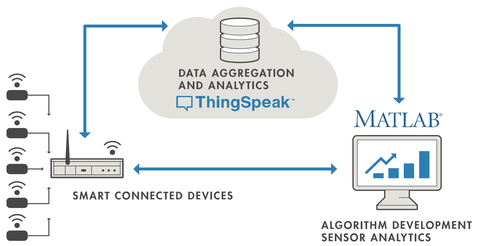

Preliminary results

- Students value the hands-on approach as it helps them quickly grasp AI hardware concepts.
- They enjoy experimenting with the codes and find it both enjoyable and beneficial.
- Our approach is seen by students as more meaningful compared to simulations or videos.
- A suggested improvement is to include additional comments in the code to assist learners with limited or no experience in the programming language.
- The majority of students have been able to successfully complete all activities.

References

Hidi, S., & Renninger, K. A. (2006). The four-phase model of interest development. Educational Psychologist, 41(2), 111–127.
Lent, R. W., Brown, S. D., & Hackett, G. (2002). Social cognitive career theory. Career choice and development, 4(1), 255-311.