Assignment 1

Description: This assignment focuses on the preliminary stages that build the foundation for the course project. The main focus is on defining the problem to be solved understanding the context surrounding it, to then engage with creative methods that will inform the device's functionality in terms of electronics and software integration.

Goal: The goal for this assignment is threefold. First, identify the problem and current state of the art; second, creatively design a prototype by capturing information for others; and third, prototype the circuitry using leveraging simulation and physical or virtual implementation depending on your project's scope.

Rationale: Familiarizing with a situation that requires a solution is a fundamental step in design. Analyzing the actions involved and understanding how others have approached the problem, provides a unique view into understanding the phenomena at hand. This information provides the baseline for applying creative methods with the goal of designing and prototyping a user input device. Finally, the output of previous processes, will inform the design of the electronics and logic driving your proposed design.

Group size: Assignments can be submitted, individually, in groups of two, or in groups of three.

Weight: The assignment is worth 15% of the final grade.

- **Mandatory requirements for grading:**
  Please note that without these, no grade will be provided.
  - Submission of working repository link.
    - The repository will provide evidence documenting the project progression.
    - The repository will also provide evidence of each team member's contribution.
    - Please ensure that the repository is either public or if private, a valid invitation is sent to both the course instructor and the TA.
  - Written report.
    - Report must follow the IEEE double column conference template.
      - Word Template: https://www.ieee.org/content/dam/ieee-org/ieee/web/org/conferences/conference-template-a4.docx
      - Overleaf Template: https://www.overleaf.com/gallery/tagged/ieee-official
      - Please note that these will be also available on Canvas. However, you **MUST** read the instructions on how to use this template. Pay particular attention to citations, cross-references, and table formatting.
    - Page limit: 2 pages not including tables, figures, and bibliography.
      - Contents (recommended length):
        - Abstract (min 150 words – max 200 words)
        - Introduction (min ½ column – max 1 column)
        - Background review (min 1/2 column – max 1 column)
        - Results (1 column)
        - Conclusion (1/4 column)
    - The written report must include at least five citations (two conference papers or journal, two websites, one patent).
    - Contributions appendix.
      - Here, each team member's role and responsibilities will be defined with a list of accomplishments and contributions.
      - This declaration will be signed by all team members.
      - It is expected that all team members contribute equally. If a contribution is not deemed to be equal, a percentage contribution will be allocated to each team member. This will be used to adjust the assignments grade.
      - Name other appendices as needed based on their contents.
  - 5 to 10-minute video report with all team members presenting.
- **Deliverables:**
  - Please note that all statements and decisions must be well supported. This will require you to include citations to research papers, market share statistics, and books amongst others.
  - **The abstract** requires you to summarize the contents of the report.
   - Recommendations:

- 1 sentence for context.
- 1 sentence for stating the problem and why is important to address it.
- 1 sentence for what you aim to achieve with this assignment.
- 1 sentence for how you aim to achieve the goal set in the previous bullet point.
- 1 sentence for what you obtained as results.
- 1 sentence stating the major takeaway from the assignment.

o **The introduction** requires you to introduce your project by including:
- Context: What current landscape is inspiring the development of the project? For example, if proposing an input device for a health condition, you can cite research papers in this domain or commercial devices that have look at the same problem and indicate why is there a problem to begin with. What is the scenario causing the problem? You can also cite statistics. For example, the number of players with the condition that could benefit from the device.
- State the problem: Use the context provide earlier to establish a gap and formulate the problem. Continuing with the previous example, the problem could be that the user input device is not ergonomic and therefore causes discomfort and fatigue, or that the device is not accessible.
- Objective. Check this link for an example https://examples.yourdictionary.com/problem-statement-examples.html
  - The problem definition should answer the following questions:
    - Where and when does the problem takes place?
    - Who does the problem affect?
    - What solutions or attempts have been made to solve the problem?
- Justification: Explain why addressing this problem matters. Answer the following questions:
  - What will happen if the problem is not solved?
  - Who will feel the consequences?
  - Does the problem have wider relevance (e.g. are similar issues found in other contexts)?
  - Back up your argument with data. For example, if you are focusing on accessibility, you could use information from the World Health Organization on the matter of interest. If you are focusing on consumer-level tech, you could use information from market share sites, such as Statista.

o **Background review:**
- The background review requires you to read a number of resources that will provide you with an understanding of other works that are aligned with the problem you have chosen to address.
- The number of sources varies according to each team's size.
  - Group of 3: 6 scientific papers, 3 commercial devices/patents, 3 solutions reported and discussed on websites (e.g., YouTube, Reddit, others).
  - Group of 2: 4 scientific papers, 2 commercial devices/patents, 2 solutions reported and discussed on websites (e.g., YouTube, Reddit, others).
  - Those working individually: 2 scientific papers, 1 commercial devices/patent, 1 solution reported and discussed on websites (e.g., YouTube, Reddit, others).
- Where to obtain these sources:
  - First, define your keywords. These are informed by the problem statement.
  - Browse for documents using multiple search engines:
    - For scientific documents:
      - https://scholar.google.com/

- https://www.researchrabbit.ai/ (highly recommended as it allows to visually find connected manuscripts)
      - Once documents are found, read them, classify them, and determine their suitability to make it into top ones for reporting in this assignment.
      - Use a reference manager such as https://www.zotero.org/ or https://www.mendeley.com/ as these can be integrated into Microsoft Word and LaTEX document. Google Docs is not recommended as it breaks the IEEE formatting.
   - In this section you are required to report the following:
      - What keywords did you use for your search and why?
      - How many results did you find, how many did you discarded (briefly explain why some documents were excluded), and why you selected the ones being analyzed.
      - What is the problem the resource is trying to address and who benefits from it?
      - How is the resource addressing the problem? This refers to the methods, instruments, and approaches used. Focus on short descriptions.
      - What was done to address the problem and how was it tested?
      - What were the results and what is your takeaway? What did you learn?

- **Results:**
   - Ideation:
      - Task analysis:
         - Create a use case for how the task is currently performed, and a use case after conducting the Design Thinking session to compare both.
         - This task is used to inform those in the Design Thinking session about the problem at hand.
         - Each team member will contribute a simple use case or work together to create a heavyweight use case that justifies the number of team members working together.
         - The task analysis will be included as an Appendix.
      - Design thinking outcome
         - Present all steps of the design thinking process using the provided template or similar (https://www.teachingentrepreneurship.org/design-thinking-101/). Please note that one will be provided in Canvas.
         - The Design Thinking template will be included as an Appendix.
         - Ideation cannot be done with one or two people. You **MUST** indicate how many people participated. Collaborate with other groups in the class and collect information from at least: projects done individually 3 people, groups of two 6 people, groups of three 9 people.
         - From completing the Design Thinking process, each group will have an idea and a paper/soap/lego/wooden/cardboard tangible prototype.
            - Please note to clearly report the Brainstorming stages and idea validation as an Appendix.
            - Include a 3D model of your prototype captured using photogrammetry using an app like MakerWorld AI (https://makerworld.com/en/makerlab/ai-scanner) or RealityScan (https://www.unrealengine.com/en-US/realityscan)
            - Submit a GLB3, FBX, or OBJ 3D model, and edit accordingly to appropriately understand its functionality.

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- Electronics prototyping
    - System architecture: Propose a system architecture based on the most promising idea identified with the design thinking process. The diagram clearly depicts the inputs, outputs, and necessary subsystem identified at this stage with a short text description. The system architecture can be added as an Appendix.
    - Please ensure the following for your solution:
        - Groups of 3: three sensors and three actuators
        - Groups of 2: two sensors and two actuators
        - Groups of 1: one sensor and one actuator
        - Example of sensors include an accelerometer|gyroscope, potentiometer, light sensor, motion sensor, force sensor, pressure sensor, and sound sensor among others.
        - Example of actuators include a speaker, a vibrotactile motor, a motor, LEDs, and a fan among others.
        - Wiring follows the indications provided in class, including but not limited to color-coding, and straight wires.
        - Soldering follows the indications provided in class.
        - Submit the electronic schematics in PDF format and bill of materials for components as an Appendix. See example below for schematics.
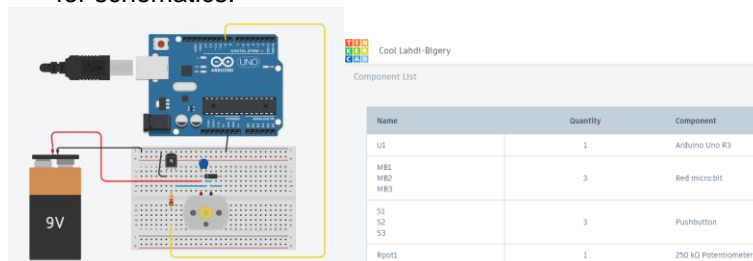
        - Submit a video of the electronics simulation that corroborates it is working. When uploading videos through Canvas or submitting a YouTube link, ensure that the video or the link work.
        - Include the code use to make the microcontroller work as an Appendix.
    - Using the system architecture as reference:
        - Prototype and simulate using Wokwi (https://wokwi.com/) or TinkerCAD (https://www.tinkercad.com/)
        - Once validated
            - Implement with real components and integrate with game engine with a simple scene that serves as proof of concept.
            - Real components may include the use of an Arduino, MakeyMakey, or Microbit board, in addition to commonplace electronic components such as, solid wiring, small breadboard, resistors, potentiometers, sensors, actuators, and buttons among others.
            - In the event that your group has decided not to acquire real components, you are required to implement a virtual twin of the electronic components and code in their functionality so that this virtual user input device can be used to interact with the scene. In such scenario, you will be required to use a mobile device that will host the

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                            virtual controller and have a physical prototype for Wizard of Oz interactions.
- Submit a video of the electronics implementation that corroborates it is working. When uploading videos through Canvas or submitting a YouTube link, ensure that the video or the link work.
  - **Conclusion**
    - Indicate the conclusion from the work presented in this report and what future work awaits. For future work, please use a Gantt chart, Kanban board or similar diagram that shows how you plan to develop the project based on the course outline and findings from this report.

Special notes:
- Please note that the use of generative AI is allowed. When using generative AI in any shape or form, you are required to:
  - Clearly indicate with a citation where was AI used.
  - Clearly outline what was your addition and contribution to the generated content.
  - Any section that does not meet these requirements will receive **ZERO** marks.

Rubric

TOTAL: /100	%	Non-existent	Exists (25%)	Basic (50%)	Decent (70%)	Well Thought (85%)	Beyond expectations (100%)
Title	2.5		The title lacks clarity and poorly outlines the problem being tackled and the solution being proposed.	The title is somewhat clear and somewhat outlines the problem being tackled and the solution being proposed.	The title requires clarifications to understand the problem being tackled and the solution being proposed. The title uses more words than required.	The title requires little clarifications to understand the problem being tackled and the solution being proposed. The title uses more words than required.	The title is clear without needing clarifications and it is written between 5 and 15 words.
Abstract	5		The abstract does not convey the required items within the word limit requiring extensive clarifications.	The abstract somewhat conveys the required items within the word limit requiring several clarifications.	The abstract conveys the required items within the word limit without requiring some clarifications.	The abstract clearly conveys the required items within the word limit requiring minor clarifications.	The abstract clearly conveys the required items within the word limit without requiring any clarifications.
Introduction	10		Presented lacking clarity, organization, and supporting evidence.	Presented with some clarity and vague direction.	Presented requiring better structure leaving room for further clarifications.	Presented missing some supporting evidence and components, with minimum further clarifications.	Clear, well written, well argued, well supported, and well-organized project description without room for clarifications showing creative and critical thinking.
Related works review	10		Presented lacking clarity, organization, and supporting evidence.	Presented with some clarity and vague direction.	Presented requiring better structure leaving room for further clarifications.	Presented missing some supporting evidence and components, with minimum further clarifications.	Clear, well written, well argued, well supported, and well-organized project description without room for clarifications showing creative and critical thinking.
Ideation All steps of the Design Thinking Process, including brainstorming	20		Presented lacking clarity, organization, and supporting evidence.	Presented with some clarity and vague direction.	Presented requiring better structure leaving room for further clarifications.	Presented missing some supporting evidence and components, with minimum further clarifications.	Clear, well written, well argued, well supported, and well-organized project description without room for clarifications showing creative and critical thinking.
"Paper" Prototype Don't forget to submit the 3D scanned model.	10		The "paper" prototype does not represent the ideation process, requiring extensive clarifications.	The "paper" prototype somewhat represents the ideation process, requiring several clarifications.	The "paper" prototype represents the ideation process, requiring some clarifications.	The "paper" prototype represents the ideation process, requiring minor clarifications.	The "paper" prototype represents the ideation process in an insightful manner without room for clarifications.
Electronics Simulation Additional sensors and actuators exceeding the minimum requirements will result in 2 bonus	10		The electronics prototype significantly lacks proper articulation with the ideation process and system architecture in	The electronics prototype somewhat lacks proper articulation with the ideation process and system architecture in	The electronics prototype lacks proper articulation with the ideation process and system architecture in an	The electronics prototype is well articulated with the ideation process and system architecture in an insightful manner. Minor	The electronics prototype represents the ideation process and system architecture in an insightful manner without room for clarifications. Wiring is well

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marks.			an insightful manner. Extensive clarifications are needed. Sensors and actuators may be missing.	an insightful manner. Several clarifications are needed. Sensors and actuators may be missing.	insightful manner. Some clarifications are needed. Sensors and actuators may be missing.	clarifications are needed. Sensors and actuators may be missing.	organized and color-coded; the distribution of elements is tidy and organized.
Electronics implementation and software integration Items properly soldered will result in 2 bonus marks.	10		The electronics implementation requires improvements. % of grade depends on the level of required clarifications. For example, proper wiring, soldering, and sensor/actuator implementation.				The electronics physical implementation represents the simulation. Wiring is well organized and color-coded; the distribution of elements is tidy and organized.
System architecture	2.5		Diagram requires clarifications and improvements. % of grade depends on the level of required clarifications.				Diagram clearly depicts inputs, outputs, and subsystem identified at this stage.
Conclusion	5		The conclusion does not convey the required items within the word limit requiring extensive clarifications.	The conclusion somewhat conveys the required items within the word limit requiring several clarifications.	The conclusion conveys the required items within the word limit without requiring some clarifications.	The conclusion clearly conveys the required items within the word limit requiring minor clarifications.	The conclusion clearly conveys the required items within the word limit without requiring any clarifications.
IEEE formatting	5	Does not comply with the template	-				Complies with the template
Video presentation	10		Requires improvements. % of grade depends on the level of required clarifications.				Video visuals, audio, content, flow, pace, and messages are clearly delivered in an engaging manner.