



## ME 218a Fall 2020: Console Wars: The PIC Menace Not long ago, right here

Grading Session on November 11 from 1-5 pm.

Project Presentation on November 11 starting at 5:30 pm.

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### Episode A THE PIC MENACE

*Turmoil has engulfed the HOME SYSTEMS. The availability of new consoles to everyday homes is in question.*

*Hoping to resolve the matter with a blockade of deadly bots, the greedy SCALPERS have reserved all preorders of the new hardware.*

*While the console manufacturers endlessly debate this alarming chain of events, the SUPREME CHANCELLOR OF ME218 has secretly dispatched twenty-five 218 KNIGHTS, the guardians of electronics and mechatronics in the galaxy, to settle the conflict....*

#### Goal:

The goal of this project is to provide a framework in which you can apply your knowledge of microcontrollers to provide an enjoyable experience for users and observers.

#### Purpose:

The underlying purpose of this project is to give you some experience building an electromechanical widget. We expect that this will involve working with sensors, driving displays, designing event-driven software, and implementing that software in C on a PIC. We expect to see all of these elements in every solution.

#### Background:

Your task will be to develop, implement, and test a Portable Interface Console Managing Anxious NERDs (PICMAN) before they die of boredom without any video games (on November 11).

#### The Task:

Your PICMAN will be built at your location to be presented to the Normally Enthusiastic but Raytracing-Deprived (NERDs) on the Internet. You should strive to make your PICMAN exciting, durable, and entertaining.

*A strange game. The only winning move is not to play. How about a nice game of chess?*

*War Operation Plan Response (WOPR)*

**Core Functionality:**

- Your PICMAN must accept input from the NERDs.
- Your PICMAN must react to those inputs by changing the display elements.
- Your PICMAN should use these inputs and outputs to implement a game.
- Your PICMAN must generate a numerical score depending on the NERD's ability to play the game.
- Your PICMAN must be capable of playing games implemented by any member of the class.

**PICMAN Operation:**

- The PICMANs will power up into a welcoming mode, offering NERDs the opportunity to interact with your PICMAN. Whenever it is in this mode it should present a "preview" of the game to draw in the NERDs.
- To make sure NERDs feel that your console is incredibly intuitive, and thus win the console wars, it should take the average NERD approximately 2 minutes to interact with your PICMAN. No one except Chris Sawyer should be able to completely master your PICMAN in less than 30 seconds.
- Processor cycles are in short supply, so to conserve resources your PICMAN must only operate when in active use by NERDs. The PICMAN should reset to the welcoming mode within 30 seconds after the NERD stops interacting with the PICMAN.
- To maximize the challenge and enjoyment for the NERDs, your PICMAN should incorporate at least one joystick axis, and at least one button.
- When the NERD beats the game, the PICMAN should provide a clear indication of the user's performance. This indication may last no more than 30 seconds before the PICMAN resets.
- The PICMAN should maintain a list of the top three high scores since it was last powered up.
- The PICMAN should be usable without the guidance of Sid Meier. Instructions should be brief and easy to understand, and must be included with all sales of the game. For good examples from real games, check out <https://www.mikesarcade.com/arcade/cards.html>.

**Basic Specifications:**

- A team of three class members will collaborate on the project development. Each member will construct their own instance of the PICMAN hardware. The team-members will collaborate on the software for the PICMAN so that the team prepares a single game.
- To allow for all game developers to target your platform, you may not use any proprietary hardware in your game console. The only allowable components are those included in the lab kit and assembled according to the SPDL hardware specification. Each PICMAN must include all of the inputs and outputs specified in the SPDL hardware specification.
- Each PICMAN must be able to correctly play games written by any of the teams in the class.
- Each PICMAN must respond to at least two distinct inputs.
- At least one of the user inputs must be a joystick axis. This axis must be interpreted in a way that makes use of the analog nature of the joystick.
- The complete PICMAN must be a self contained entity, capable of meeting all specifications while connected only to the provided project power supply.
- No glitter!

- While it is normally not a good practice, the finished circuitry may be constructed on your solderless bread-boards. This has been done to allow you the maximum time to spend on your project, without having to learn electronic prototyping techniques as well. Be sure to secure the bread-board and connections so that they will not be disturbed by NERDs while playing games.
- Accurate schematics and state diagrams are such a useful aid in debugging that you should be prepared to show your up-to-date schematic or state diagram to any coach or TA whenever you ask them for help on your project.
- You are limited to an expenditure of **\$75.00 / team** for all materials and parts used in the construction of your project. Materials supplied to each team by SPDL, from the lab kit, or the Cabinet Of Freedom do not count against the limit. All other items count at their fair market value. If it's an issue with something from the kit, we will provide a replacement for free, but we can't guarantee latency. **We do not expect you to purchase any additional components for this project.**

### Safety & Hygiene:

- The PICMANs must be safe for both users and spectators.
- No glitter!
- No part of the PICMANs may become ballistic unless completely constrained within the PICMAN.
- No pyrotechnics or fire of any kind! Electronics only work when the magic smoke stays inside, so do not release any. Be advised that smoke contains chemicals known to the State of California to cause cancer, birth defects, or other reproductive harm<sup>1</sup>.
- Your lab kit contains small parts. Be advised that some of these parts may be a choking hazard for small children. Please store your components accordingly.
- Uncooked potatoes are slightly poisonous, so exercise caution.

## Checkpoints

### Design Review:

During the day on **October 27** we will conduct design reviews via Zoom. Signups for the 40-minute slots for 2 teams will happen via a Google Sheet. Each group should prepare a few **simple** PowerPoint slides (scans of sketches are OK). **No code, no state diagrams, no circuits.** The slides should show your concepts, a preliminary event list with responses, and a list of how you are going to meet the user interface requirements. You will present these to other members of the class, members of the teaching staff and coaches so that all may hear about your ideas and provide feedback and advice. At this time you will be required to identify the core functionality of your proposed design and how it meets the interaction requirements.

*This is where the fun begins.*

*Anakin Skywalker*

### First Checkpoint:

On or before **11/2/20**, you must submit a schematic of the required functionality on 10/27/20 and a refined set of events with details on the responses. A KiCad schematic of your hardware configuration should be uploaded to Gradescope as a PDF. Only one team member needs to submit your checkpoint documentation.

*I don't like sand. It's coarse and rough and irritating and it gets everywhere.*

*Anakin Skywalker*

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<sup>1</sup>Proposition 65, California Health and Safety Code §25249.6 et seq.

## Second Checkpoint:

On or before **11/5/20** you will be required to demonstrate a minimal level of function:

- The hardware & software necessary to do each of the following:
  - sense all inputs
  - draw something to the display based on each of the inputs

*Now this is Podracing.*

*Anakin Skywalker*

## Third Checkpoint:

On **11/8/20** you will be required to demonstrate integrated functionality of all sensing inputs, plus software and timing, plus drawing to the display. In other words, everything should be complete with the exception of improvements in user experience. You should start exchanging games with your classmates at this point to prove out inter-operability.

*I am the Senate.*

*Chancellor Palpatine*

## Grading Session:

On **11/11/20** from **1:00 pm to 5:00 pm** you will be required to demonstrate your fully integrated and finished gaming console. At this point you will need to demonstrate not only playing your game but also demonstrating the ability to load and play a game from another team.

*Only a Sith deals in absolutes.*

*Obi-Wan Kenobi*

## Public Presentation:

This will take place on **11/11/20** at **5:30 pm** on the Internet. At this event, you will have the opportunity to showcase your console to friends, family, and the broader 218 community.

*Do. Or do not. There is no try.*

*Yoda*

## Report:

Draft due on **11/16/20** by 4:00 pm. The final version (with revisions incorporated) is due by 5:00 pm on **11/20/20**.

*It's over, [students]. I have the high ground.*

*Obi-Wan Kenobi*

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## Evaluation

### Performance Testing Procedures:

All PICMANs will be tested by a demonstration, performed by a team member, that should show all of the possible user interactions.

### Grading Session Presentation:

Each team should prepare a 30 second (no more) presentation to introduce their PICMAN. This presentation should highlight the unique features of your console and game, **not the circuit or software details**. As an example, think back to the xylophone descriptions that were played on the first day of class. You will be setting up your PICMAN, one at a time, and delivering your presentation on the Internet between 1:00 pm & 5:00 pm on the day of the presentations. During this time each team and their PICMAN will be photographed.

## Grading Criteria:

- **Concept (20 %)** This will be based on the technical merit of the design and coding for the PICMAN. Included in this grade will be evaluation of the appropriateness of the solution, as well as innovative use of hardware and software in the solution.
- **Implementation (20 %)** This will be based on the prototype displayed at the evaluation session. Included in this grade will be evaluation of the appearance of the user interface and quality of construction.
- **Performance (40 %)** Half of this (20 %) will be based on the results of the checkpoints, the other half will be based on the results of the performance testing during the evaluation session. Full performance credit will be given only if the game works on the first attempt during the grading session. Performance will be judged first on the ability to demonstrate the core functionality and second on any embellishments to the core functionality. **To earn the performance points, you must demonstrate at least the core functionality.**

- **Report (10 %)** Preliminary project reports are due **November 16, 2020** at 4:00 pm. The report should be in the form of a stand-alone web site and must include schematics, pseudo-code, Highlighted header & code listings, a complete Bill-of-Materials (BOM) for the project as well as a 1 page description of the game and a “Gems of Wisdom for future generations of 218ers” page.

To submit your report you must enter the URL to your site into a Google sheet that will be made available for that purpose. The only file types in your final report should be HTML (including style sheets if you choose), JPEG or other viewable image files and PDF files. Schematics should be PDF files, not bitmaps (PNG, JPEG, GIF, etc.). A reasonable resolution bitmap place-holder with a link to a PDF is the best solution to readability. **Do not** simply place a link to the PDF of the schematic without a viewable preview on the web page. **Do not** include .doc, .docx, .xls, .xlsx or other files that require opening a separate application outside of the browser. **Do not** embed video files directly into your site. If you want to include video, link to YouTube or other video sharing site.

It is critical that the URL of your report be in the Google sheet on time so that the peer reviewing team will have an adequate opportunity to review it before class the following day.

Final versions of the reports, incorporating the review comments are due (again, as a URL in the Google Sheet; update the URL if it changed) by **5:00 pm on November 20, 2020**. Make sure to test all of your links before submitting. If we can't simply open the link and read it on our machines, then we can't grade it.

- **Report Review (10 %)** These points will be awarded based on the thoroughness of your review of your partner team's report. Read the explanations, do they make sense? Review the circuits, do they look like they should work? If, during grading, we find things that don't make sense or circuits that won't work we will consult your review. If the review caught them, then the team will lose points on their report. If the reviewers missed it, then they will lose points for their review. The report review should be submitted in the form of a Word document that you should upload to Gradescope by 4:00 pm on 11/17/20.

## Suggestions

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We understand that the project definition is probably a bit more open than you might be used to. To help you get your creative juices flowing we offer some reflections that you might want to consider.

- Think of clever ways to use the required inputs. Your displays don't have a whole lot of pixels—how can you use them to convey the most information as clearly as possible?
- **The Tao of 218:** Simplicity Leads to Reliability. Remember, you only have 460 hours and 40 minutes available to complete the project (and tend to the other things in your life) before it is due.

### **Exercise your creativity:**

We encourage, and hope to foster, a wide range of solutions to the problem. This will make for the most enjoyable gaming experience for your users. There is no “best” way to solve this problem (or best problem to solve), so don’t spend time looking for it. While brainstorming, consult your favorite video games for inspiration. You may find the games developed for early arcade cabinets or your graphing calculators to be well suited for implementation on a PIC.

Remember that we interact with electronic devices every day. ME218 is an opportunity to design things that are **fun** and **whimsical**. Take advantage of that.

### **Make your project robust:**

You’ll be playing your game a lot as you develop and debug it, so make sure that your breadboard wiring is neat and robust. There’s nothing more frustrating than debugging your project for hours only to find you’ve knocked a wire loose.

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## Resources

### **Websites:**

[The Video Game Museum](#)

### **Local Stores:**

[Anchor Electronics](#) in Santa Clara

[J&M Hobby House](#) in San Carlos

[Jameco](#) in Belmont

[TAP Plastics](#) in San Mateo

### **Gems of Wisdom:**

Be sure to check out The ME218 Archive ([me218archive.stanford.edu](http://me218archive.stanford.edu)) for guidance from past generations. Pay more attention to software tips than hardware tips.