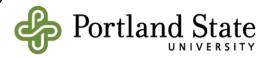
# Assign Final Project

#### Overview

- Requirements:
  - Your final project must be at least as complex as any of the other projects
  - You must demonstrate your project on the Nexys A7 board, but you can use additional SBC's, sensors, mobile devices, etc.
  - Your project must be an SoC w/ embedded CPU and custom hardware and software
    - Your project must make use of the embedded CPU in a <u>significant</u> way
    - ☐ Your project <u>does not</u> need to use RVfpga as the embedded CPU
  - Your results must be visible and should be interesting to class
- Can be done in teams of 2, 3 (preferred) or 4 (w/ sufficient justification)
  - Final project teams are self-assigning like we did for the other projects. Use the final project teams group in D2L
  - Final project teams will make use of GitHub



#### **Timetable**

- Proposal submitted to D2L by 10:00 PM on Sat, 27-Feb... earlier would be better to get a faster turnaround
- Written final project progress reports submitted to D2L by 10:00
  PM on Sat, 12-Mar
- Zoom-based Demo Day on Tue, 16-Mar from 2:00 PM 4:30 PM (tentative)
  - If one or more of your team membes have a conflict w/ another final exam or final project I will try to adjust the demo schedule to meet your needs
- Deliverables pushed to GitHub and uploaded to D2L by 10:00 PM on Thu, 18-Mar
  - We will use GitHub and GitHub classroom for the final project
  - We are asking you to also submit a .zip file of your GitHub repository to D2L as a backup
  - NO LATE SUBMISSIONS ACCEPTED w/o PERMISSION IN ADVANCE



#### Scope

- You may use:
  - The switches, buttons, display, LEDs on the Nexys A7
  - Other Nexys A7 peripherals (accelerometer, temp sensor, XADC, mic...)
  - Digilent (<u>https://store.digilentinc.com/pmod-modules-connectors//</u>) and Maxim Semiconductor have a variety of Peripheral **mod**ules (for additional functionality
  - Additional peripherals connected to the board (ex: ESP8266 for WiFi, VGA monitor, sensors, SBC's etc.)
  - Proto-strip or proto solder boards for external components

#### PROCURE ANY ADDITIONAL HW YOU NEED IMMEDIATELY!!!

- Online distributors <u>Digikey</u>, <u>Mouser</u>, etc.
- <u>sparkfun.com</u>, <u>adafruit.com</u>, <u>seeed studio</u> and other hobbyist sites (see Circuit Cellar)
- Surplus Gizmos (<u>surplusgizmos.com</u>)



#### **Project Proposal**

#### Your project proposal should include the following:

- Project name and team members
- Project description
  - What are you going to build?
  - □ What component(s) will you use?
  - ☐ Block diagram of your design as you envision it
- Design aApproach
  - ☐ How are you going to build it?
  - How will you demonstrate success (committed and stretch goals)?
  - What are your options if you start running out of time?
    - It helps to structure your proposal as committed functionality and "stretch" functionality
- Milestones
  - Weekly target dates to demonstrate that you're making acceptable progress towards completion



#### Grading

- Grading will be as follows:
  - Project progress report and demo presentation 5%
  - Final project presentation at Demo Day 20%
  - Correctly implements committed functionality 40%
  - Quality of design report 15%
  - Quality of code (comments, clarity, etc.) 15%
  - Degree of difficulty 5%
- Extra credit (up to 8 pts.) is possible if you go above and beyond your accepted proposal...and if the design report is good, your code is well commented, your demo works, etc.
- You are encouraged to submit, by email or in a 1-on-1 conversation w/ me, confidential reviews of your team members' performance (good and bad – the earlier the better
- □ The Final Project is 25% of your final grade

#### **Deliverables**

- Design Report:
  - Overview of your project including an English description of the circuit's function
  - Block diagram of your circuit
  - Design details, including a theory of operation, state transition diagrams or equivalent, etc.
  - Results (good and bad)
  - Contributions of individual team members
  - No more than 10 pages please

The purpose of your design report is to provide insight into your implementation. A design report with an appropriate level of detail and nicely organized and commented code are a pleasure to grade (and you want us to be happy when you're grading your project...don't you). Use the pages wisely. We don't need pages and pages of full-size figures or long blocks of code. Be concise and provide descriptions and/or explanations for the code snippets, figures, etc.



#### Deliverables (cont'd)

- □ Demo video. The video should be narrated by one of the team members and demonstrate the committed (and "stretch" if you completed them) features from your approved proposal
  - It is a good idea to have this video ready for your final project presentation – your presentation and demo will go more smoothly if you have a video to show during demo in case, or in lieu of, trying to do a "live" demo during a Zoom meeting
- Source Code:
  - Listings of all <u>your</u> SystemVerilog files (you do not need to include test benches)
  - Listings of <u>your</u> program source code for the embedded CPU(s) in your design
  - Your code should be liberally commented and use descriptive signal and/or variables names
- .ppt or .pdf, etc. of your final project progress report and demo presentation
- bit and executable files We may try running your project
  - Include instructions in a Readme file if they are needed to run the project



### Combined ECE 540/ECE 558 project

Since several of you are taking both ECE 540 and ECE 558 this term we are willing to consider joint projects that meet these requirements:

- At least one of the team members must be enrolled in both ECE 540 and ECE 558 this term
- Your final project must be at least as complex as any of the other projects in either course
- The project needs to meet the requirements for both the ECE 540 and ECE 558 final projects
  - Your project must include an SoC w/ embedded CPU and custom hardware and software running on the Nexys A7
  - ☐ Your project must include an Android app interfaced to the SoC running on the Nexys A7 board
  - ☐ The scope of the development effort for the SoC and the Android app must be comparable
- Work with Roy before the proposal is due to agree on concept and scope of the project
  - Be prepared to discuss the concept and work-breakdown (who will be doing what)
  - Final decision on what is acceptable as a combined project is Roy's



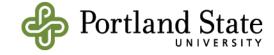
#### Project Ideas

- Add keyboard and/or mouse input and do something interesting (ex: a card game or slot machine)
  - There are several open source mouse and keyboard interfaces in VHDL and Verilog. If you use them acknowledge the source
- Creative video graphics/games
  - Arcade-style games (not Duck Hunt, Pong, Pacman, or Snake...I've seen too many of those)
- □ Enhance the RojoBot (add additional sensors, weapons, etc.)
  - BotSim RojoBot simulator source code is available on request to Roy
- ☐ Build something "physical" (ex: robot platform)
- Implement a link between two Nexys A7 boards or a Nexys A7 and a single-board computer (ex: Arduino, RPI, etc.) as part of a "visually interesting" application
  - ex: Two player Battleship game
- Make use of a network connection (Ethernet, BLE, WiFi, wireless radio) to enhance your perhaps with a mobile app
  - ex: wireless irrigation system or IoT system



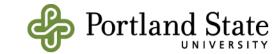
#### Project Ideas (cont'd)

- Expand one or more of the RVfpga Labs
- Use a different soft core CPU (ex: ARM DesignStart or FPGArduino) and interface it to peripherals
- Do something that involves lighting
  - Addressable LED Strip: <a href="https://www.sparkfun.com/search/results?term=addressable+led+strip">https://www.sparkfun.com/search/results?term=addressable+led+strip</a>
  - Addressable LED Panel: https://www.sparkfun.com/search/results?term=led+panel
  - Electroluminescent Panels:
    - □ CAUTION: requires high-voltage circuitry
    - □ <a href="https://www.sparkfun.com/search/results?term=EL+panel">https://www.sparkfun.com/search/results?term=EL+panel</a>
  - Check Circuit Cellar and Elektor for project ideas



#### FPGA Project Resources

- www.opencores.org Open source HDL IP cores
  - Wide variety of functions not necessarily optimized for FPGA
- www.fpga4fun.com Lots of fun FPGA projects
- www.xilinx.com



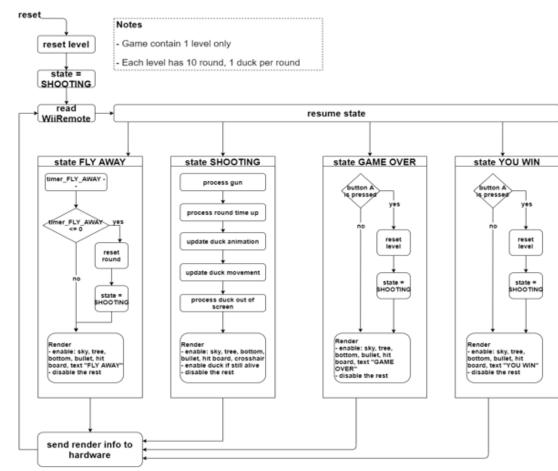


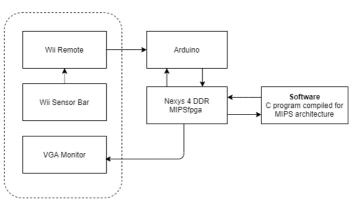
#### Winter 2020 "Wall of Fame" winner



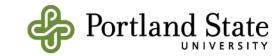
**Duck Hunt** 

Thong D., Ramprakash B., Abhiraj AE





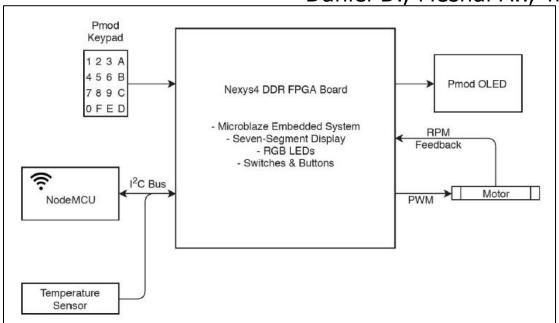
Demo video: ...\videos\DuckHuntFPGA Demo Video.mp4



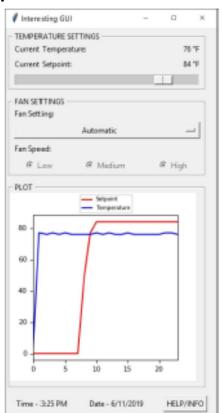
## Spring 2019 "Wall of Fame" winner

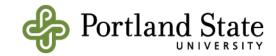
# IoT-based Thermostat Controller (Combined ECE 558/544 Project)

Daniel D., Meshal A., Tristin K.







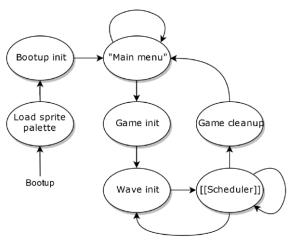


#### Winter 2019 "Wall of Fame" winner

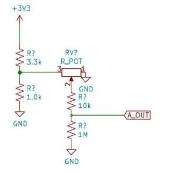
#### **Invaders from Space**

Bradon K., Grant V., Brian H., Jamie W.











Actual protoboard plugged into Nexys A7

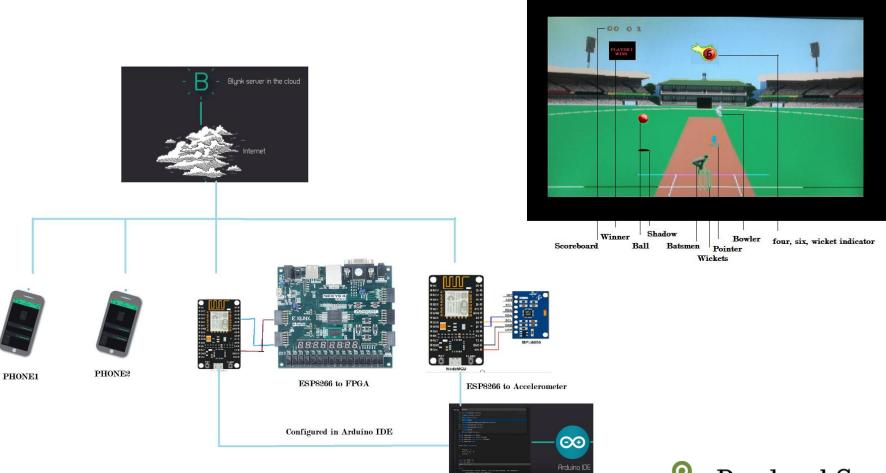


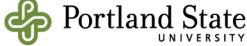
Simplified high-level program flow

#### Fall 2017 "Wall of Fame" winner

#### **Motion Cricket**

Varun Krishna Kayala, Vamsi Krishna Reddy Puritipati, Pradeep Reddy Pachika





## Other resources – a small sampling

- https://learn.digilentinc.com/- Project ideas, contest winners, etc.
- http://www.elektor-labs.com/ Project ideas, kits, etc.
- http://www.clubjameco.com/index.php/contents More project ideas, kits, etc.



# This space available for you

