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## Assign Final Project

### Final Project

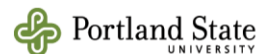
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- ☐ Requirements:
  - Your final project must be at least as complex as any of the other projects
  - You must demonstrate your project on the Nexys A7 board but you can use additional SBC's, sensors, mobile devices, etc.
  - Your project must be an SoC w/ embedded CPU and custom hardware and software
    - ☐ Your project must make use of the embedded CPU in a significant way
    - ☐ Your project does not need to use MIPSfpga as the embedded CPU
  - Your results must be visible and should be interesting to class
- ☐ Will be done in teams of 3 or 4 (4 preferred)
  - 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

## Final Project Timetable

- ☐ Proposal submitted to D2L by 10:00 PM on Wednesday 27-Feb-2019... earlier would be better to get a faster turnaround
- ☐ Project progress reports in class Tue, 12-Mar and Thu 14-Mar (if needed) in class
  - ~12 minutes per team. Be prepared to discuss your progress and challenges
  - Powerpoint presentation is encouraged but not required
- ☐ Demos on Thursday 21-Mar-2019 from Noon – 2:30 PM
  - Location is TBD. Will be in CH 71 unless notified
  - If you have a conflict w another final exam or presentation I will adjust the demo schedule
- ☐ Deliverables pushed to GitHub and uploaded to D2L by 10:00 PM on Friday 22-Mar-2019
  - We will use GitHub and GitHub classroom for the final project
  - We are asking you to submit a .zip file of your GitHub repository to D2L

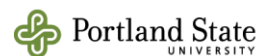
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## Final Project

- ☐ You may use:
  - The switches, buttons, display, LEDs on the Nexys A7
  - Other Nexys A7 peripherals (accelerometer, temp sensor, XADC, mic...)
  - Digilent ( <https://store.digilentinc.com/pmod-modules-connectors//> ) and Maxim Semiconductor have a variety of Peripheral modules (Pmod) for additional functionality
  - Additional peripherals connected to the board (ex: VGA monitor, wheels, motors, sensors, radios, SBC's etc.)
  - Proto-strip or proto solder boards for external components
- ☐ **PROCURE ANY ADDITIONAL HW YOU NEED IMMEDIATELY!!!**
  - EPL store (EB basement past the elevators)
  - Online distributors [Digikey](#), [Mouser](#), etc.
  - Surplus Gizmos ([surplusgizmos.com](http://surplusgizmos.com))
  - [sparkfun.com](http://sparkfun.com), [adafruit.com](http://adafruit.com), [seeed studio](http://seeedstudio.com) and other hobbyist sites (see Circuit Cellar)

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## Project Proposal

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The project proposal form is posted on D2L:

- 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 Approach
  - How are you going to build it?
  - How will you demonstrate success?
  - What are your options if you start running out of time?
    - It helps to structure your proposal as committed functionality and "stretch" functionality
- Milestones
  - Target dates to demonstrate that you're making acceptable progress towards completion

Proposal Form: <..\misc\ECE 540 Blank project proposal form.docx>

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## Final Project Grading

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- Grading will be as follows:
  - Project progress and demo presentation – 15%
  - Correctly implements desired function – 50%
  - 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**

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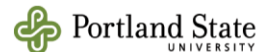
## Deliverable Expectations

### ☐ 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 12 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.

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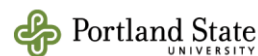


## Deliverable Expectations (cont'd)

### ☐ Source Code:

- Listings of all of your (System)Verilog files (you do not need to include test benches)
  - Listings of your 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 .elf files – We may try running your project
- Include instructions if they are needed to run the project

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## 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 (Pong, Space Invaders, Snake, Pacman, ...)
- ☐ 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, Galileo, RPI) 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

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## Project Ideas (cont'd)

- ☐ Use a different soft core CPU (ex: MIPSfpga or ARM DesignStart or FPGArduino) and interface it to peripherals
- ☐ Do something involving lighting
  - Addressable LED Strip:  
<https://www.sparkfun.com/search/results?term=addressable+led+strip>
  - Addressable LED Panel:  
<https://www.sparkfun.com/search/results?term=led+panel>
  - Electroluminescent Panels:
    - ☐ **CAUTION: requires high-voltage circuitry**
    - ☐ <https://www.sparkfun.com/search/results?term=EL+panel>
  - Check Circuit Cellar and Elektor for project ideas

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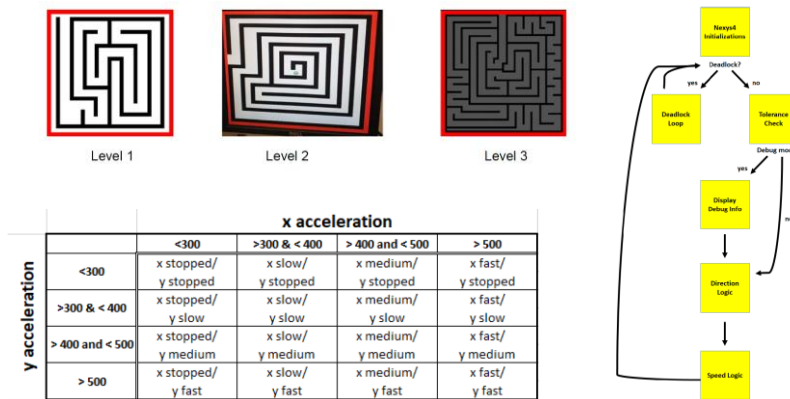




# Fall 2018 "Wall of Fame" Runner-up

## Toadly Amazing

Jonathan Anchell, Chelsea Brooks, Michael Bourquin



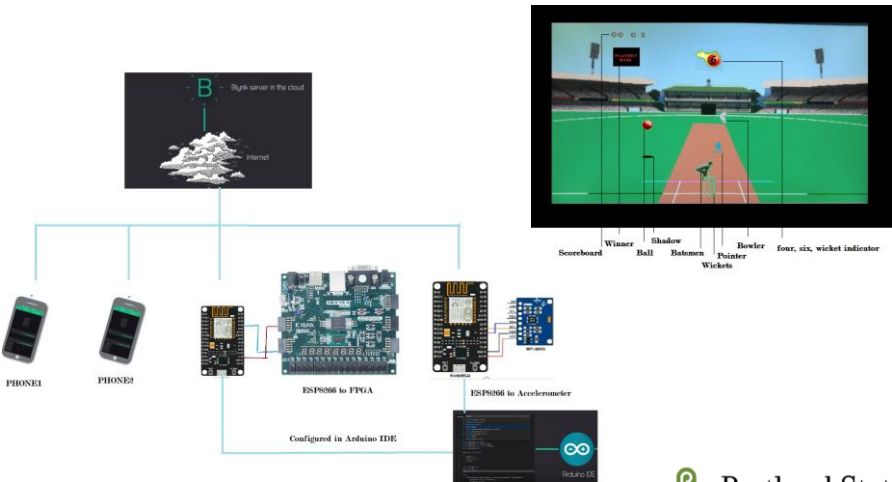
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# Fall 2017 "Wall of Fame" Winner

## Motion Cricket

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



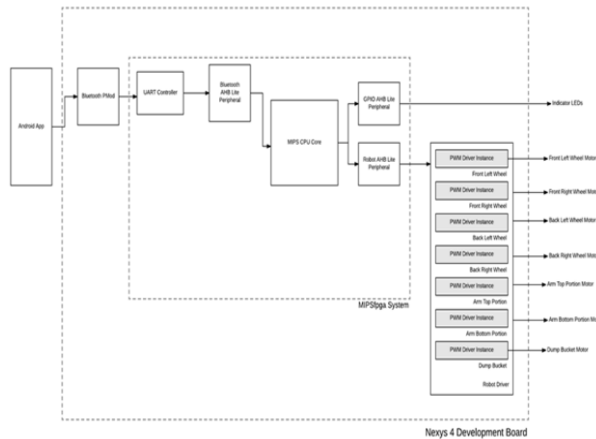
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## Fall 2017 "Wall of Fame" Winner

### Wally 1.0 – A Trash Collection Robot

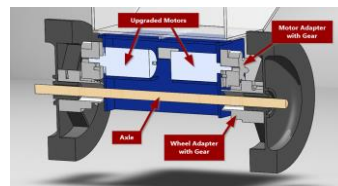
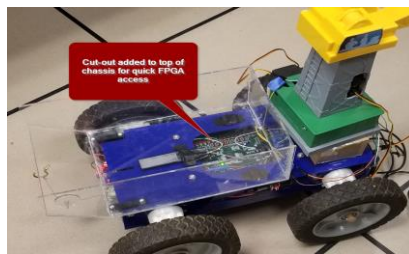
Alex Varvel, Daniel Collins, Roman Kuleshov, Maksim Pakhnyuk



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## Wally 2.0 (ECE 544 Winter 2018)



- Microblaze CPU with I and D caches, floating point unit, debug unit, 128K local memory
- Clock generator with
  - 100MHz system clock
  - 50MHz SPI block
  - 500KHz I2C clock
  - 10Mhz camera clock
- Interrupt controller with 12 interrupt inputs
- 6 AXI Timers - 1 for FreeRTOS tick, 5 for motor PWM
- Watchdog timer to monitor system
- 2 GPIO blocks - 1 for 32-bit camera data, 1 for 8-bit motor direction and light strip control
- Quad SPI controller for retrieving firmware image from flash memory
- 2 UartLite controllers - 1 for Bluetooth, 1 for COM port debug statements
- IIC controller for Pmod IOXP - unused in final design but still supported and mapped
- MIG SDRAM controller

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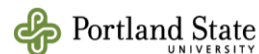


## FPGA Project Resources

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- ❑ [www.opencores.org](http://www.opencores.org) – Open source HDL IP cores
  - Wide variety of functions – not necessarily optimized for FPGA
- ❑ [www.fpga4fun.com](http://www.fpga4fun.com) - Lots of fun FPGA projects
- ❑ MIPSfpga Lab Projects
  - [..\misc\MIPSfpga\\_Labs\\_Overview.pdf](..\misc\MIPSfpga_Labs_Overview.pdf)
  - See me for access to the workshop material
- ❑ [www.xilinx.com](http://www.xilinx.com)

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## Other Resources – a Small Sampling

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- ❑ <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.
- ❑ Circuit Cellar and Elektor magazines...each magazine has 5-6 projects/issue...a few are FPGA-based
  - Last few issues of each magazine are posted on D2L

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Winter 2019 "Wall of Fame" Winner

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**This space  
is  
available  
for you**

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