

Goal-Focused Design in an Introductory Lab Course

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Description of course

Physics 140

- Circuits for 2nd semester freshmen
- Variety of backgrounds but mostly no electronics
- Heavily content focused (Analog and digital, AC and DC, ICs, etc.)
- 2 hour lab with 1 hour workshop/lecture/help session
- Procedural (including final project)
- 90-100 students including physics majors and minors and a few others



Students were afraid of their audio amplifiers

- Students did not have a strong grasp of the purpose of the individual parts of the circuit
- Unwilling to refine when output did not meet expectations
- Satisfied with mediocre results
- Feared touching anything

Without an understanding of goals/purposes, it is difficult to design/refine/build.



Changes to the course

- Final project chosen by students
- Workshop time used for collaborative design and planning
- Significantly more open-ended labs



Have students set the goals of the project

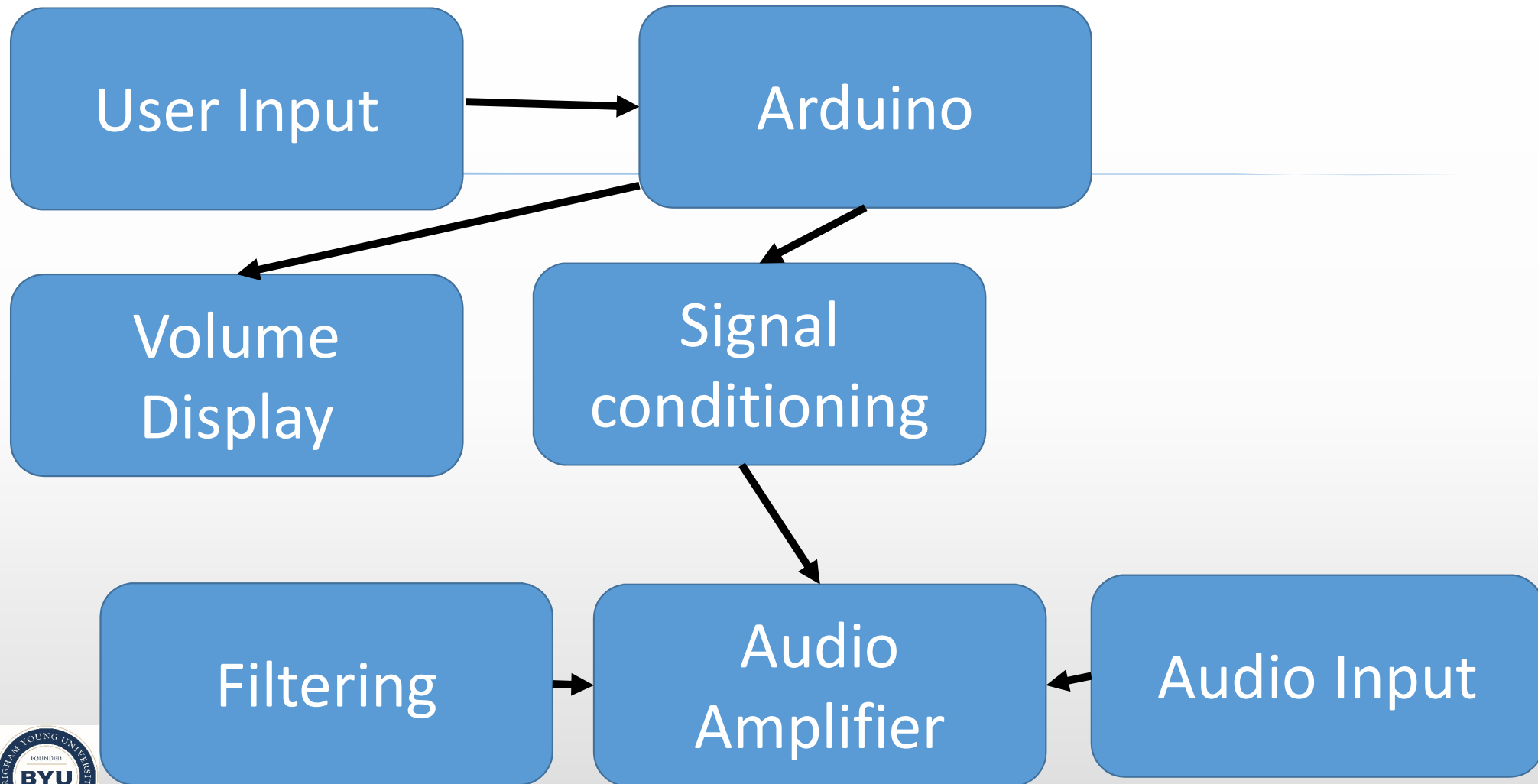
- Students set goals that they feel are achievable
- Students set goals that they can understand and test
- Students set goals that are actually not achievable in the way that they plan to achieve them
- Reduced cognitive load from trying to determine what the instructor wants

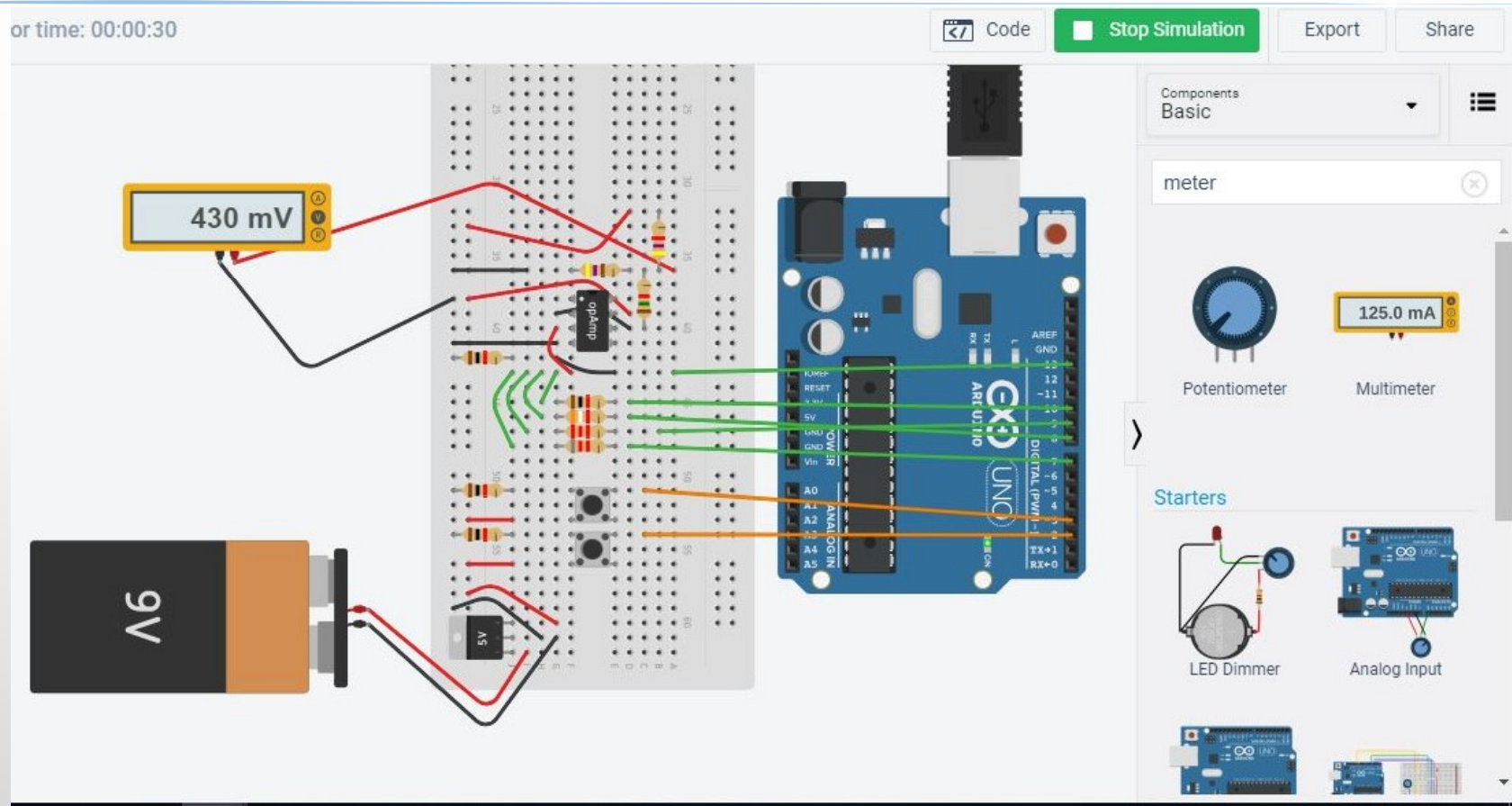


Project Rubric - Design

- Main goal is specified, including the purpose, scope, and desired functionality.
- The project should be broken down into sub-tasks or sub-components.
- Each sub-component should be designed. At least one sub-component should be tested using tinkercad.
- Appropriate calculations should be completed for each sub component of the project.
- A project map should describe how each sub-component fits together to meet the goals.







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Project Rubric – Building and testing

- Documentation of steps taken to complete the project should be kept. This includes successes, failures, and lessons learned.
- Documentation of procedures used, data taken, and analysis made at each testing point. Documentation should demonstrate that you tested and characterized the individual pieces as you went.



Project Rubric – Building and testing

- Documentation is also a way to help students realize what it takes to contribute meaningfully to an open-source community or team.



Project Rubric - Functionality

- Individual parts of the project work as intended
- Individual parts of the project work together as a whole



Comments

- Similar percentage of projects were completed
- Content coverage was reduced (*i.e.*- 511 timers, Flip Flops, etc.)
- Students understood and were much more willing to refine their project.
- More work for the instructor
- Students discussed further changes they want to make to the project after the semester is over
- Student comments indicate that they recognized that design saved them time in the long run (Less of a plug and play perspective)

