

# CprE 488 – Embedded Systems Design

## Final Project Proposals

**Assigned:** Thursday of Week 9

**Due:** Thursday of Week 11

The conventional Machine Problem (MP) assignments will be ending after MP-4, with the last several weeks of the semester reserved for a final team-based project. The parameters for this project are as follows:

- We will be expanding on some portion of the existing lab infrastructure, as developed from MP-0 through MP-4.
- Each project must have significant system design (i.e. hardware) AND software design aspects.
- We have several additional peripherals available (mostly in PMOD form) beyond those used so far in the labs. If your project requires a modest purchase, let us know early in the process.
- The default assumption will be that you will work with your existing project team. Teams can be combined (total team size is limited to 4), but the scope of the proposed project must be commensurate with the size of the team.
- There will be two presentations – a 7-minute presentation on the project proposal (due Thursday of Week 11) and a 15-minute demo of project results (due during Finals Week).
- Each project should be unique, and project ideas will be on a first-come, first-serve basis. Post on Blackboard when you have an idea in mind – that post should include at the very least a few sentences describing what you'd like to do and what technology you'll be designing along the way.
- Since each project will be different in both scope and technical focus area, there will be no single fixed grading rubric. Instead, as part of the project proposal presentation, please specify the grading rubric that you feel is appropriate. See below – each rubric should add up to 200 points, with completeness being a major grading criteria.
- Grading will be determined by an evaluation of this rubric, with 50% of the score based on the instructor evaluation, and 50% of the score based on the average evaluation of the other students in the class.

Beyond these parameters, you have the freedom to propose any project relevant to the course. Some starter suggestions (this list is by no means exhaustive, please contact us or post on Blackboard with your ideas):

1. Software-defined radio – port GNU Radio to the ZedBoard and demonstrate various frequency ranges.
2. Gesture recognition – use various sensors create an interface for some purpose (e.g. directing the rocket launcher, flying the quad)
3. Image processing for intelligent object tracking – use some hardware image processing core to assist with tracking objects.
4. Multi-factor authentication – use the audio, keypad, and other sensors to authenticate access to the Linux system running on the ZedBoard.
5. Audio processor – use the microphone and audio out to perform some sort of analysis (e.g. speech synthesis, music synthesis)

6. Oscilloscope – configure the built-in ADC to sample signals and create a nice interactive GUI that displays the output.
7. Robotic platform – use the servos and Digilent motor robot kit to create a ZedBoard-driven CprE 288-style robot
8. Home theater – port an existing home theater controller (media player) to Linux running on the ZedBoard
9. Dead reckoning system – use the gyros / accelerometers to track a person carrying the board and relay information such as walking cadence.
10. Stereoscopic imaging – use multiple ZedBoards to record or display 3D images.
11. Audio tracking – use multiple microphones to triangulate an object’s location based on sound.

**1) What to Submit.** On Blackboard, please submit a brief presentation (in PDF format) that describes your proposed project, with a list of goals and a timeline, as well as your grading rubric. A sample grading rubric is provided below:

Attributes	Proficiency/Performance Scale		
	1: Beginning - Unsatisfactory - Low level	2: Accomplished – Satisfactory – Medium level	3: Exemplary – Beyond Satisfactory – High level
Authentication via number entry	Keypad integrated in design, software not functioning correctly [25 points]	Keypad presses can be captured and compared to stored value [50 points]	Use of cryptography to securely store and check input [75 points]
Authentication via audible password	Microphone integrated with system, limited data [25 points]	Volume levels and simple patterns can be differentiated via software [50 points]	Speech recognition – the passphrase can be consistently detected [75 points]
Authentication via gesture recognition	Simple sensors integrated with system, limited functionality [25 points]	Simple movements can be detected and compared to stored values [50 points]	Complex multi-movement gestures can be used for authentication [75 points]
Demo and report	Limited demo and report [25 points]	Full demo, report includes description of all major components [50 points]	Entertaining demo, report also includes detailed figures and system evaluation results [75 points]

While this rubric is appropriate for the “multi-factor authentication” project idea, your project’s rubric will be specific to your goals. Please set the goals in such a way that being “satisfactory” in all categories will add up to 200 points.

Also, while there are three set categories of completeness in this rubric, it is intended as a baseline, so for example, a project could receive 40 points for the “Audio authentication” score. Likewise, you are not required to have exactly four attributes and three categories of completeness. Create a rubric that provides a natural breakdown of the project goals and tasks, and provides appropriate credit for completeness via unambiguous milestones.