Term project and lab guidelines: CSE321 Realtime Embedded systems Fall2019
Bina Ramamurthy

1. Overview You are required to design, implement, demo and present a realtime embedded system product. You will decide on an idea and get the approval of the instructor or the TA. This is an individual project and we are expecting every one of you to work on a unique project by yourself. The goal of this assignment is to develop *an ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics.*

2. Approach
You will develop the project in three phases, each phase with its own deliverables. You will be graded on these deliverables.

2.1 Phase 1 (Lab 1) (Due date: 9/27/2019 5pm)

2.1.1 The Idea: You will research the application domains of realtime embedded systems and explore the sociocultural scene and human landscape around you, industry trends, and discover the needs. Understand the challenges in these domains you are exploring and help address these. A fine example is from [1]. This talks about an urgent need for blood for transfusion delivered by drones. (Delivery by drones could be a good project idea.)

2.1.2 Formulate the problem and design the solution: Formulating *the problem* (description) that you are planning to solve begins with identifying the users, use cases and how they will interact and benefit form your product. Draw the *UML use case diagram* [2] representing your project product. You can use draw.io (https://www.draw.io/) or lucid chart or tools such as these for drawing the diagrams. From the use case diagram discover the components and use *the CRC model* (classes, responsibilities, collaboration) [3] to discover the modules of your product. Obtain at least one card representing your project. There may be more, one for the original problem, one for the hardware module and one for the software module. Capture design details in *UML class diagrams, block diagrams and interaction sequence diagrams* to describe a possible solution. By this stage, you should a clear idea of the components you need for engineering your product. Order the components or discuss it with your instructor about the availability of the components from the cse321 lab. For example, I can provide a drone (Phantom 4) for drone projects, Arduino, and related components. Make a *detailed list of components* and tools (e.g. soldering iron, multimeter), their purpose and where to procure them. Discuss with the TA and place the order for and/or collect all the necessary components and tools.

2.1.3 Deliverables of phase 1 (Lab 1): (Due date: 9/27/2019 5 pm.)

1. Problem title and statement - clear and detailed -- minimum 100 words (15%)
2. UML use case diagram explaining the problem (15%)
3. CRC cards explaining the modules of the solution and their responsibilities (15%)

4. UML Class diagram and architectural block diagram (20%)
5. UML Sequence diagram (15%)
6. Components list with details of the status (on hand, got it from an instructor--name, ordered) (15%)
7. All these items (1-6) recorded in a single document with a suitable name box identifying you and the project, and the PrjPhase1V1.pdf submitted on Timberlake. (5%)

2.1.4 Outcomes of phase 1: On completion of this phase you will able to analyze a problem and design and represent a solution and procure the components for implementing the solution.

2.2 Phase 2 (Lab2) (Due date: 11/8/2019 by 5 pm)

2.2.1 The Prototype: Phase 2 of the lab involves implementing the idea and the design you developed in Phase 1.

2.2.2 Implement the solution: Use the Prj1Phase1.pdf design document as a guideline and implement the modules identified in the CRC card and detailed in the other UML diagrams. Construct the *hardware components* and test them. Choose a suitable programming language. Program and simulate the *software components* and debug them. Put the components together and test the integrated components. Meet with the TA during recitation and office hours to get help and to keep them updated on your progress. More important is to document the prototyping and testing details for later submission. Don't forget to record any issues you faced and how you addressed them. This phase may include *photos of prototype(s), test scripts and test patterns.*

2.2.3 Deliverables (Due date: 11/8/2019 by 5 pm)

A working prototype of the software and hardware components and the integrated system. A short demo to one of the TA about the status of the prototype is required. Here are the deliverables of this phase.

1. Hardware component prototype (~30%)
2. **Software component - codebase** (~30%)
3. The test scripts and patterns (data) (20%)
4. Photos of the prototype (10%)
5. Observations and notes (10%)
6. All these items (1-5) recorded in a single document with a suitable name box identifying you and the project, and the PrjPhase2V1.pdf submitted on Timberlake. (5%)

2.2.4 Outcomes of phase 2: On completion of this phase you will be able to develop and implement a prototype based on a design document.

2.3 Phase 3 (Term project) (Due date: 11/22/2019 by 5 pm)

2.3.1 The final product: This phase is about putting it all together. Compare the design in Phase 1 and its implementation in Phase 2. It may be necessary to go back to phase 1 and adjust the design details in case any changes were needed in the original design; let the updated document be *PrjPhase1V2.pdf*. Same with the phase resulting in an updated document PrjPhase2V2.pdf. Fine-tune the prototype to meet the non-functional requirements. For example, you may have to adjust the drone's delivery function so that it delivers closer to its target by some metric. Make changes to the phase 2 prototype to finalize the product. Give it a *marketable name*.

2.3.2 Document: Create a *video* of the working of the final project. Add a *readme file* that tells a user how to deploy, use, and interact with the product. Create a 6-slide (min) presentation with these items:

2.3.3 Deliverables (Due date: 11/22/2019 by 5 pm)

Create a folder with the structure and gather all the items shown in figure 1 for the three phases. Submit a compressed zip file.

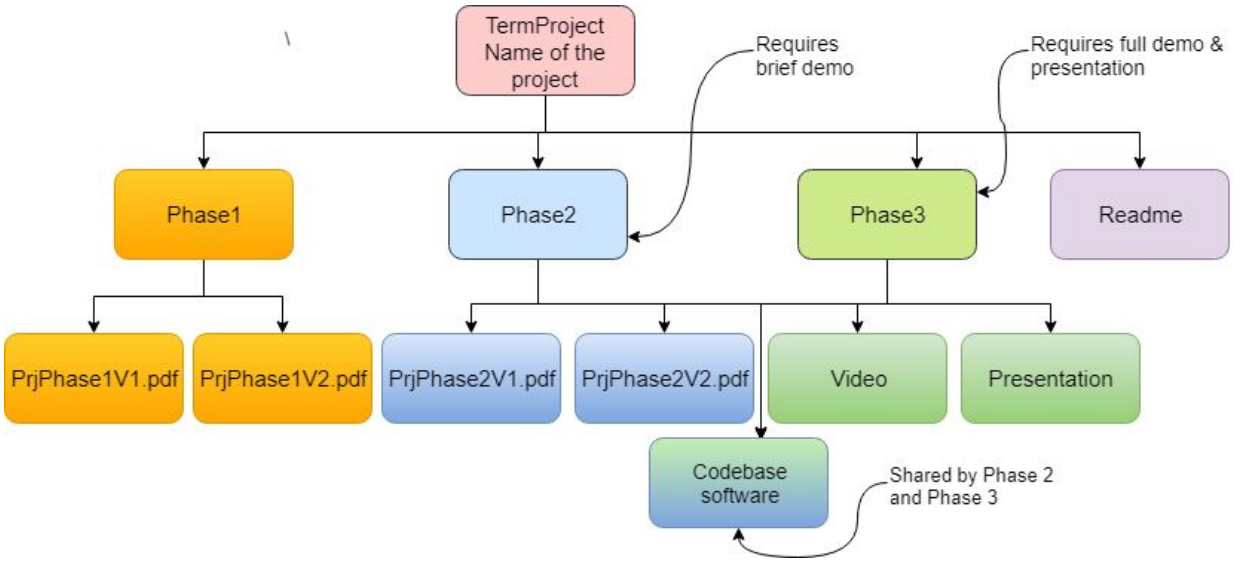

Figure 1: Project organization and directory structure

1. Capture a video of the project (20%)
2. TermProject.zip file (40%)
3. Present your project to TA, or instructor (40%)

2.3.4 Outcomes of term project:

On completion of the term project you will *be able to provide a* problem formulation (analysis and design) and a solution for it by applying principles of engineering, science, and mathematics principles.

3. Project rules and requirements

- This project cannot be a repeat and reuse of a project from another class.
- It should have realtime and embedded system components (specify the percentages for each: RT (%), EM (%))
- Make sure you pay attention to the due dates and plan accordingly.

References

1. Eliza Strickland Engineering change in Africa: Facing urgent needs, African nations are pioneering new technologies - [Spectral Lines] IEEE spectrum, you can get the issue and all its articles by searching UB libraries. Publication Year: 2019, Page(s): 4 - 4
2. UML use case diagram, http://www.agilemodeling.com/artifacts/useCaseDiagram.htm, last viewed in 2019.

3. Class Responsibility Collaborator (CRC) Models: An Agile Introduction, CRC card modeling. http://www.agilemodeling.com/artifacts/crcModel.htm last viewed in 2019.