Proposal for Small project

New Software Design and Development Lab For SFWR ENG 3KO4/3MO4

Kamran Sartipi[1] and Andrey Feldman[2]
Computing and Software[1], and ECE[2], McMaster University

Problem Statement

Software Engineering 3M04/3K04 are courses that are specifically designed for students in the Electrical and Computer Engineering (ECE) programs. These courses aim to teach ECE students the fundamentals of the software design and development process. An integral part of the course is the software lab sessions held every week for a group of 25-30 students per session. In the previous years offering of these two courses the labs included a small simulation project with 10% of the total course mark that to my believe could not meet its goal of educating the students on how to design and develop a software system. Last year I taught SE3KO4 for the first time and during the term I designed a new lab that aimed to expose the students to a real environment to design and develop a practical mid-size software system. This new lab was evaluated as 30% of the course total mark. Ideally this new lab setting would provide significant impact on the quality and usefulness of these two courses. However, I experienced many difficulties as follows:

- **Lack of background:** the ECE students lacked the required programming background for such a software design course. In fact, they were supposed to know C language but practically that was not the case at all. Also, a design course requires the design skills to obtain the system requirements and make design decisions based on the system requirements. The subject of software design deals with some abstract quality aspects of the system that to some extent are difficult to grasp easily.

- **Lack of motivation:** SE3KO4 is a service course offered by Computing and Software to ECE; the nature of a service course caused the students' reluctance to put the same amount of efforts they usually put in a core ECE course.

- **Imperfect lab descriptions:** this was a new lab that I designed concurrent with the flow of the course material, therefore it was rather impossible for me to produce perfect lab descriptions.

Goal

The goal of this proposal is to attack the above difficulties that I faced in offering a software design lab for SE3KO4. This proposal intends to provide proper solutions that substantially enhance the state of the previous lab, provide a structure to the project, and result in a higher level of project understanding by the students. This proposal would suggest the following strategies:

- **Strategies to resolve lack of background**:
    - Allow a smooth start-up with the project. The first two labs are allocated to writing small programs in C to establish a standard level of programming knowledge for the class.
    - Provide examples from a small system (e.g., a Thermostat System) to show how to prepare each deliverable document such as: requirement specification, design, and code.

- **Strategies to resolve lack of motivation**:
    - Invite ex-students of SE3KO4 that have used the skills in this course to secure a job and to tell the success stories.
    - Identifying skilled students and assigning each to a different group to coach that group.
    - Providing step-by-step instructions on how to prepare the deliverables.

- **Strategies to improve the lab documents:**
    - Provide design specific templates for every deliverable document, this will result in all documents having the same format but different contents. (templates can be based on the IEEE standards that adjusted to the course needs).
    - Provide the "solution documents" for every deliverable in this project.
    - Develop "stub modules" that will simulate the behavior of the components of the system that are not being developed by a student group. In such a way students will be able to see an actual working system before the whole system is designed.
    - Provide TA instruction sheet to explain TA duties for every specific lab as well as marking schemes to mark each deliverable.
    - Provide identification documents for every group to fill out their information and their background.

Alternative

I consider myself as an expert in this field. I have successfully experienced such a software project in CAS 703 Winter 2004 that was very well accepted. I myself have conducted such projects during my studies at the University of Waterloo in a Software Engineering course. Therefore, this proposal is a natural way of dealing with a software design lab that has been tailored to the needs of the ECE students, which makes it special. In case that I could not see significant improvement on the level of student understanding and appreciation by this project, other alternatives would be designed and attempted next year.

Evaluation

The following evaluation criteria are suggested:

- Measure the progress of the project by randomly interviewing with the groups of students after each project deliverable.
- Asking questions during the term tests about the design decisions made by the student groups to perform the project. It is expected that the students fully grasp how different design decisions may affect the quality of the system in general.

Description of the Software Project: Design and implementation of an Automated Banking Machine (ABM)

The students will design and implement an ABM system that automates simple banking transactions. A user interacts with the system through a card reader, a numerical keypad, a small screen, a statement printer, a slot for envelope, and a key-operated switch for system start-up and shutdown. The user can withdraw money after authorization; a small display screen allows messages and information to be displayed to the user. Other functionality of the ABM system include: view and print account balances; make cash withdrawal; deposit cash or check; transfer money between accounts; handle security issues; interface with bank system, and keep track of the money stock.

Steps in the Labs

1. Each group of students produce the requirement specification and design document for a complete Automated Banking Machines (ABM) using the structured design technique and the modularity principle.

2. Each group implements only one module of the ABM system using C language and will interface it with a pre-designed system.

3. Student groups will merge into two or more companies and select their leaders who will organize the integration of the modules (developed by different groups) into working ABM systems and test them.

4. Finally, each company will demonstrate their design and running system to the whole class (or ideally to the public).

Title of the labs:

- **Lab 1**: C language review.
- **Lab 2**: Formal specification of module interface, and implementation.
- **Lab 3**: Requirement elicitation for the ABM system.
- **Lab 4:** Tutorial on MIS/MID and UML for software design.
- **Lab 5:** Architectural design using component diagram and statecharts.
- **Lab 6**: Architectural design review for quality assurance and module design.
- **Lab 7**: Implementation of one ABM component and black-box testing.
- **Lab 8**: Code review, component interfacing, and test against specification.
- **Lab 9:** Project demonstration.

Feasibility and Dissemination

The proposed lab improvement is completely feasible; we have identified all the resources and have provided a detailed "to do list" on how to proceed. A qualified student (Mr. Andrey Fledman fourth year Engineering Management student) who has taken SFWR ENG 3KO4 last year with me has eagerly expressed his willingness to help me in this lab construction. The result of this work would be presented as the *"Lab Project Requirements for SFWR ENG 3KO4/3MO4"* that will be available for the future instructors and students of these courses.

Schedule and Requested Funding

This project (lab improvement for software design and development) requires significant amount of work. However, since funding for small projects has a maximum limit, we ask for the maximum amount of $1000. Andrey will prepare the documents as noted above and I would review it. We would hold weekly meetings and I would expect that Andrey spend 10 hour per week starting from now to the end of August to prepare the first draft of *"Lab Project Requirements for SFWR ENG 3KO4/3MO4* document."

With regards,
Kamran Sartipi

Instructor for SFWR ENG 3KO4
Department of Computing and Software
Email: sartipi@mcmaster.ca