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Computer Engineering
CEN3907C

M2: Design Prototype

Overview

As a team, you will complete and deliver a ***design prototype*** demonstrating the feasibility and core features of your project. The prototype should not involve implementations of all aspects of every feature; instead, the design prototype is intended to provide a basis for architecture and practical testing (including usability and user experience). The prototype deliverable's goal is to identify exactly how the project will be structured and provide a foundation for the second phase of the project. The design prototype should represent approximately 50 hours of work per team member, or about 150-250 person-hours for the entire team (excluding design documentation).

Specification

The deliverable should meet the following requirements. As each design project is unique, it is natural that projects may not spend time equally on all areas herein. For example, a research lab project is likely to place more effort to establish Evidence of Soundness, with particular focus on basis in prior research work. By comparison, a hardware or software product project is likely to focus more on External Interfaces and Internal Systems. Teams are expected to focus their prototype as appropriate for the project type. The following information is provided in addition to the ***General Project Requirements*** (see M0 specification).

Progress Report

The report will be submitted to Canvas as a PDF. Word counts exclude references, titles, and captions.

Effort Breakdown

Progress (including preparatory research / evidence gathering, experimentation, design, and implementation) must be commensurate with approximately 45-50 hours of work per team member. As such, experimentation, failed attempts, and difficulties should be ***clearly documented***. This information may be presented as a table.

Evidence of Soundness

Design projects are not merely a reiteration of existing technology; instead, they are expected break new ground by providing value and filling a societal need. However, all new technology targets come with the risk of failure. As such it is critical to establish the soundness of a project – evidence that it is possible – though prior work and/or experimentation. For the purposes of the design prototype, this should be included as part of a report covering all critical elements. The length will vary depending on the project and should include appropriate figures and tables. For projects that are heavily research-based, the report may be no more than 3000 words, excluding references (approx. 4 journal article pages with figures); however, for primarily applied projects, this section is expected to be about 1-2 journal article pages (750-1500 words).

Theoretical Background

For aspects of the project that have not been implemented (either by others of the project team), a theoretical foundation should be provided from scientific literature.

Prior Art

Some approaches used in projects have been implemented / applied by engineers in the past. Teams should identify this prior work as a foundation and form of evidence of viability of approach.

Empirical Evidence

From time to time, teams will need to experiment in order to establish the viability of aspect of a project. Empirical evidence should include the goal of experimentation, methodology, results, and interpretations.

Project State Summary

Briefly review the current state of the project, including external interfaces (user-facing) and internal systems (modules, components, etc.). The summary should cover relevant and critical parts of the project; however, this section is not intended to be exhaustive. Instead, it should contextualize the work completed up to now.

Artifact

The result of the project work should incorporate the following elements. (***This is not a report!***)

External Interfaces (Artifact)

All engineering artifacts have some user (which may include consumers, designers, and/or engineers, for example). External interfaces include all the ways that users interact with the system itself – including interactive elements, programming interfaces, and network user-facing services. The interfaces should demonstrate the aesthetic of the project artifact(s) should be integrated into the prototype submission.

Presentation

Major user interface elements (tactile, graphical, or auditory) should be accessible and usable. Options and state must be accessible. For interactive interfaces, the currently selected button(s), menu option(s), or other dialog element(s) should be highlighted. Features should be discoverable.

Perception

Interface must be responsive. Interactions with interface must be indicated by sensory experience (via visual, audible, tactile, or other means). Changes in application state should be indicated on or neare relevant interface elements. For in-progress designs, unambiguous descriptions elements should be provided.

Usability

Except where explicitly otherwise by design, the interface should react predictably, i.e., for the same input and use case, it should yield the same result. When and if the interface behaves unpredictably, it must be for a clear and compelling reason (e.g., random number generation for cryptographic functions). Any aesthetic issues that are present should not cause the artifact(s) to be unusable.

Internal Systems (Artifact)

In addition to user-facing elements, engineering projects have internal systems that must be designed to carefully interact with one another. These systems are typically hidden / abstracted from the point of the view of the user, and the user need not understand or interact with these systems. Nevertheless, these systems provide the backbone for the need that the artifact will or hopes to fill.

Component Architecture

The prototype should demonstrate the project's conceptual architecture, including all major systems and components. Software elements should include building with all major libraries; hardware should include basic connections between components or emulation thereof. For elements to be built in the second phase, the prototype should include (at a minimum) unambiguous schematics of how major components connect.

Communication Mechanisms

The way components transmit information within and between systems should be demonstrated as part of the prototype. This should include the media for communication (e.g., wire or radio wave), communications protocols (including network protocols), and context for communication (time/place/condition). Specific components are required for communications should also be demonstrated, or if not yet available, simulated.

Resilience

Error correction and recovery mechanisms should be incorporated into the internal systems of the prototype as necessary to adequately address function. Where correction and recovery mechanisms are incomplete and unnecessary to demonstrate basic prototype functionality, placeholders may be utilized, with clear indication that full implementation will be integrated into the final project iteration.

Project Documentation (Third Party Logs)

The project repository should include a README outlining the work that was specifically completed in this milestone and all known bugs.**Failure to document bugs is grounds for grade reduction.**

It is also ***critical*** that all teams have time-stamped third-party evidence (e.g., remote source code repository pushes, online documents, and/or action logging) of all effort invested in the project. Teams may include additional documentation, as necessary, to demonstrate the work completed. **Failure to establish sufficient evidence to prove effort investment will result in a proportional grade deduction.**

Submissions

Students will submit a report in PDF format on Canvas. The report should include the following:

- Effort (percentage) breakdown of time spent on evidentiary **research**, **interfaces**, and **systems**
- Literature review as evidence of soundness, including theory, prior art, and experimentation
- Links and descriptions sufficient for course staff to build and run your project (within reason)