Engineering Notebook

Senior Design

Ryan Flinchum

**September 5, 2023: Project Initiation and Requirements Identification** We initiated our project today, emphasizing the comprehension of its scope and the delineation of requirements. As the Scrum Master, I spearheaded brainstorming sessions to pinpoint potential features and functionalities, advocating for a distinct roadmap and confirming the Digilent Nexys A7 board for our initial implementations.

**September 7, 2023: Resource Allocation and Task Distribution** I directed our team in cataloging essential materials and dividing tasks, ensuring clarity in each member's responsibilities. This session was pivotal in structuring our approach to the project's multifaceted requirements.

**September 12, 2023: Defining Architecture and Technical Details** Our conversations progressed into the architectural and technical specifications of the project. I led the determination of the architecture, centering on the integration of a Xilinx MicroBlaze soft-core CPU and stressing the formulation of a comprehensive plan to navigate technical challenges.

**September 14, 2023: Vivado Setup and Debugging Guidance** I executed an in-depth walkthrough for the installation of Vivado, tackling common issues to harmonize the development environment across our team.

**September 19, 2023: Reviewing Progress and Sharing Insights** We convened to assess our progress, focusing on coding endeavors and issues encountered with Vivado implementation. I encouraged the sharing of individual research findings, aiming to enrich our collective knowledge and refine our approach.

**September 21, 2023: MicroBlaze Familiarization Session** I conducted a tutorial on MicroBlaze, aiming to deepen our understanding of its implementation and associated challenges, reinforcing our team's problem-solving capabilities.

**September 26 & 28, 2023: In-Depth Exploration of MicroBlaze and IPs** I navigated our team through an exploration of MicroBlaze and various IPs, highlighting their integration and the potential complexities within our system.

**October 3, 2023: Preparing for Implementation on Digilent Nexys A7** We shifted our attention towards the implementation on the Digilent Nexys A7 board, with me leading the planning and testing phases to ensure hardware compatibility and necessary modifications.

**October 5 & 10, 2023: HTML Interface Design Discussions** We deliberated on HTML design aspects, exploring user-friendly interface patterns and dynamic content integration for our web server. Conrad took the initiative to redesign the HTML and identified the scripting used by the example webserver design.

**October 17 & 19, 2023: FreeRTOS "Hello World" Deployment and Debugging** Our focus was on deploying and debugging a FreeRTOS "Hello World" design. I devoted substantial time to assisting Ricky, Morgan, and Jack with this task.

**October 24, 2023: Enhancing Collaboration and Managing Backlog** In collaboration with Ricky, I embarked on constructing an example design project on his Vivado. We revisited and updated our sprint backlog, aligning it with the semester's objectives following customer feedback. This included dividing our efforts between hardware/FPGA and software teams, with a significant emphasis on communication for the hardware team.

**October 31, 2023: Sprint Deliverables Discussion and Environment Troubleshooting** I organized a meeting to strategize on sprint deliverables and finalize our development setup, assisting the team in resolving Vivado and SDK installation issues. My contributions extended to refining diagrams and adapting to Vivado 2018.1 for STDIO connections in our design. Within the SRS, I eliminated redundant requirements, enhanced formatting, and revised existing requirements based on feedback. The SDS was augmented with a Context Diagram, a Use Case Diagram, comprehensive TA feedback integration, and detailed descriptions for each diagram.

**November 7 & 9, 2023: Documentation Refinement** I steered our efforts in refining the Software Design Document (SDD), Software Requirement Specification (SRS), and Test Plan to ensure their comprehensiveness and accuracy.

**November 14 & 16, 2023: FreeRTOS WebServer Development** Under my guidance, we commenced the development of the FreeRTOS WebServer, focusing on integration issues and fostering a dynamic problem-solving environment.

**November 19-20, 2023: Comprehensive FPGA Redesign and Debugging** I invested 18 hours in a complete overhaul of the FPGA block design, meticulously integrating MicroBlaze, the memory interface generator, the Ethernet block, and all necessary components for MicroBlaze interrupts, AXI interface, and clock generation. Challenges addressed included memory FPGA pin locations and memory clocking rates, culminating in the establishment of correct rates at 100 and 200 MHz.

**November 21, 2023: SDK Integration and Preliminary Testing** The SDK was seamlessly integrated into our design, followed by board upload testing that confirmed partial functionality through ethernet link LED indicators, shedding light on the PHY's clock rate.

**November 23, 2023: Final Presentation Preparation and Documentation Refinement** I led the creation of our final presentation and the meticulous refinement

**1/16/2024: Refining Our Project Vision**

Today, we refined our project's vision to focus more on the software development side, given that the FPGA hardware has already been developed. Our aim is to significantly enhance Ingenion's Total Verification System (TVS) by introducing a Xilinx MicroBlaze soft-core CPU on an Artix 7 FPGA, running FreeRTOS. This upgrade is expected to enable an interactive web server that can handle TCP over Ethernet, allowing for telemetry readings and command operations with satellite hardware components. Initially, we're implementing this on the Digilent Nexys A7 development board, with the intention to port it over to the TVS as a seamless plug-and-play package.

**1/18/2024: Tackling Debugging and Ethernet Issues**

I've hit some snags with debugging our original design but am making good progress. It seems like the issues are Ethernet-related. I'm diving deep into the echoserver design to verify Ethernet functionality and am on the hunt for the BIT file for our Nexys A7 design to ensure everything checks out.

**1/23/2024: Team Members Report Progress**

Jack and Conrad have just got their Microblaze & GPIO example design up and running. It's encouraging to see parts of our project coming together like this. Their success boosts my confidence in handling the Ethernet issues I'm facing.

**1/25/2024: Coordinating Team Efforts and Overcoming Technical Hurdles**

I've been deeply involved in deciding which example designs we'll tackle this semester. I picked designs that ensure everyone can both learn and contribute meaningfully. Today, I'm focused on the Original Nexys 4 DDR echoserver design with Hamilton. We've stumbled upon a misconfiguration in the MIG but, after consulting a detailed PDF, I've managed to set the correct MIG clock rates and settings. It's a relief to see the echoserver design working correctly, confirming the microblaze and Ethernet functionality.

**1/27/2024: More Team Successes**

Morgan and Ricky successfully recreated the MicroBlaze Helloworld Design today. It's great to see each team member's design coming to life; it really shows the progress we're making as a group.

**1/31/2024: PHY Chip Verification**

Hamilton and I have been working closely on the echoserver design, and today, we've verified the PHY chip is functioning as expected. This was a critical piece of the puzzle for ensuring our design's reliability in terms of physical layer communication.

**2/05/2024: Focusing on Documentation**

With the project moving forward, I'm dedicating tonight to update and upload the deliverable documents, specifically the SRS & SDS.

**2/07/2024: Preparing for the Presentation**

This morning, I reached out to everyone to plan our project presentation. It's important that we all agree on who will present what. Last night, everyone worked on their parts, and today, I'm diving into refining our presentation further. It's essential that we communicate our project's achievements and learnings effectively. 2/07/2024: Preparing for the Presentation

**February 12, 2024: Presentation Success and Feedback**

Our presentation received positive feedback, highlighting our technical innovation and proficiency. The feedback we received was constructive, prompting us to identify areas for further refinement, particularly in user interface and system robustness.

**February 17, 2024: Strategic Planning After Feedback**
Following the presentation, we held a strategic planning session to outline our next steps, focusing on addressing the feedback by enhancing the user interface and resolving technical issues, aligning our project closer with our objectives.

**February 22, 2024: Documentation Updates**
We updated the Software Requirements Specification (SRS) and Software Design Description (SDD) documents to version 2, incorporating feedback and outlining our future strategy. These updates are essential for keeping the project on track.

**February 27, 2024: Progress on Interface Design**
Significant advancements were made in redesigning and implementing new webpage features and user interfaces, moving us closer to our goal of a more intuitive and engaging user experience.

**March 4, 2024: Enhancing System Functionality**
We focused on system enhancements, including debugging and creating new webpages for AXI read/write operations, and addressing GPIO connection issues, crucial for the system's usability and stability.

**March 9, 2024: Refining the Web Server's Interface**
The team continued refining the web server's interface, focusing on creating a user-friendly and navigable design, significantly improving user interaction.

**March 14, 2024: Overcoming Technical Hurdles**
Our expertise was highlighted as we resolved technical challenges, enhancing system responsiveness and stability, showcasing our dedication and technical prowess.

**March 19, 2024: System Stability Achieved**
We reached a pivotal milestone: ensuring the design's stable and repeatable operation, a testament to the team's hard work and dedication.

**March 20, 2024: Commencing the Final Sprint**
With the semester's end approaching, we are working on the final sprint, focusing on final enhancements and preparing for a comprehensive project review.

**March 25, 2024: Final Sprint Tasks Progress**
we concentrated on refining the web server's interface and resolving remaining technical issues, essential for delivering a polished product.

**March 30, 2024: Completing Interface Enhancements**
We made significant progress in finalizing the web server's interface, focusing on enhancing user engagement and ease of navigation, based on the latest feedback.