Senior Capstone Project Proposal

Project Team ID: Team 12

Project Title: Raspberry-Pi based System for Large-File Support (ClusterGit)

Team Members

Member	Name	Email
Team leader	Lauren Robison	robila02@pfw.edu
Member 1	Conner Reiter	reitca02@pfw.edu
Member 2	Sasha Tapinsh	tapiak01@pfw.edu
Member 3	Brandon Springer	spribm02@pfw.edu
Member 4	Sean Sikora	sikosp02@pfw.edu

Faculty Advisor

Name / Title	Professor Jay Johns
Office	ETCS 125M
Phone	260-481-6343
Email	jdjohns@pfw.edu

Project Description

Type	Application development
Abstract	Platforms such as GitHub impose strict limits on file size and encryption, making them impractical for coursework submissions in disciplines that produce very large files. This challenge is especially evident in game development courses, where Unity projects often begin at ~2 GB and can easily grow to 4–8 GB per assignment. For example, a summer course with 45 students and six assignments could generate over 3.2 TB of data; with replication for fault tolerance, capacity needs climb to nearly 6.5 TB. GitHub, with its 100 MB per-file restriction and ~10 GB repository guideline, cannot accommodate this scale. To address this, we propose a self-hosted, distributed file submission system built on a cluster of five Raspberry Pi 5 devices. The system will support user account management, large file uploads and downloads, and layer Git with Git-annex to remove size and encryption barriers. This design ensures students can reliably submit assignments regardless of file size, while instructors and students retain access to the work even after the course concludes. Our project sponsor, Professor Jay Johns, runs summer game development courses. This system is being designed specifically to assist him in managing student submissions, while also serving as a replicable model for other academic programs. Upon completion, the project will deliver a scalable, open-source, and low-cost submission platform featuring customized version control with rollback support.

Requirements	**Semester 1: Get the System to Work**
	1. Cluster Infrastructure *Functioning Raspberry Pi 5 cluster where all nodes are visible and schedulable* 1.1. Prepare Pis with Ubuntu Server, networking, and SSH access. 1.2. Install and configure K3**s** so all nodes join the cluster and can run workloads. **2. Containerization & Storage** *Distributed storage system that replicates large files across Pis* 2.1. Deploy and test workloads with K3s orchestration. 2.2. Deploy Longhorn for replication across nodes. 2.3. Test persistence of multi-GB files across nodes. **3. Git Workflow** *Git-based submission system supporting multi-GB, encrypted files* 3.1. Layer Git-annex on Git to handle large file storage. 3.2. Enable encryption for secure submissions. 3.3. Provide simple CLI commands for students (upload) and instructors (download). **4. Validation** *Proven prototype handling real-world submission sizes.* 4.1. Simulate upload of a 4–8 GB Unity project. 4.2. Measure storage usage and performance. 4.3. Verify that the system is containerized, orchestrated, encrypted, replicated, and retrievable. **Semester 2: Application & Optimization** **5. Encryption and Secure Transfer** *Ensuring that all data is encrypted when at rest and in transit* 5.1. File encryption at rest 5.2. Encryption for files in transit

	6. User Auth and Access Control *User authentication using Supabase* 6.1. Login system with user authentication 6.2. Users and access control, who can push, pull, and delete **7. Developing a User Interface** *Perfecting the UI and connecting it to a domain name* 7.1. Creation of UI with honors student 7.2. Acquire a domain name for online access **8. Testing and User Feedback** *Final polishing for the UI and feedback from users* 8.1. Test user interface and eliminate potential errors 8.2. Get user feedback from both students and instructors 8.3. Revise interface based on user feedback 8.4. Repeat until product is ready for deployment
Optional features	● 3D printed frame for the Raspberry Pis and local intranet setup ● Virtual IDE for distributed development on low-cost devices ● Security, easy access through credentials, and other infrastructure security improvements. and document integrity and security ● Quality Assurance and maintainability, ensure long term file integrity and system maintainability and scalability, with resources such as a NAS ● Replication monitoring and auto-heal of lost nodes
Required resources (HW/SW)	<u>Hardware:</u> ● Raspberry Pi 5 8GB (5) ○ 1 master/controller, 4 workers ● M.2 SSD Hats (4) ● Storage space: Currently, 2TB SSD (2) ● 32GB microSDHC (3)

	• Network switch and local intranet setup • Stable power supply • Peripherals such as monitor, mouse, keyboard <u>Software:</u> • Operating System: Ubuntu Server • Infrastructure: Raspberry Pi 5 cluster • Containerization & Orchestration: K3s • Replication: Longhorn • Version Tracking: Git • Large File Handling & Encryption: Git annex • User Authentication & Database: Supabase
Technology disclosed? If so, what?	None
NDA or IP assignment agreement requested?	None
Other notes	The group has agreed to meet on campus Tuesdays in room NF278 with Professor Jay Johns from 4:30pm to 6:30pm. NF278 will contain our hardware setup and the team lead will have a key. There is a secondary meeting day for the team on Fridays in room ET109 from 1:00pm to 3:00pm. The primary way of communication between group members will be with Discord. Collaboration and documentation is a shared Google Drive folder, and the code and documentation pertaining to it will be stored in a shared Github repository. Professor Johns also has access to the Google Drive and Github repository.

As a member of Project Team, I agree to attend project meetings regularly, participate in developing project actively, and make a full effort to complete this project as proposed.

Advisor 9/5/2025
Team Leader Date

Sean Sikora 9/5/2025
Team Member 1 Date

9/5/2025
Team Member 2 Date

9/5/2025
Team Member 3 Date

9/5/2025
Team Member 4 Date

As the Faculty Advisor, I agree to meet regularly with the student project team, manage their activities, and participate in the evaluation of project deliverables.

9/12/25
Faculty Advisor Date

As the Project Sponsor, I agree to communicate with the student project team as needed to provide information related to project scope, requirements, assumptions, constraints or other items that may impact project success, and to participate in the evaluation of project deliverables.

Project Sponsor 9/12/25 Date

Technology and ECCN:
"If your project involves 'technology' that is either (a) not publicly available or (b) includes proprietary source code (not executable files), then it requires an ECCN." 'Technology,' for this purpose, is defined as "information necessary for the development, production, use, operation, installation, maintenance, repair, overhaul or refurbishing of an item. Technology may be in any tangible form, such as written or oral communications, blueprints, drawings, photographs, plans, diagrams, models, formulae, tables, engineering designs and specifications, computer-aided design files, manuals or documentation, electronic media or information revealed through visual inspection."

Interactive tool to determine ECCN:
https://www.bis.doc.gov/index.php/export-control-classification-interactive-tool

NDAs and IP Assignments:
The sponsoring company typically has NDAs and IP assignment forms that it wishes to use. Neither the NDA nor the IP assignment is an agreement with Purdue directly; these agreements are between the students and the sponsoring company. Of course, our office can review the company-provided documents to be certain it aligns with Purdue's standards. Alternatively, our office has draft agreements which we could provide for the sponsor's use. Again, as NDAs are between the student and the sponsor, Purdue cannot be a party to or advise the sponsor or the student on the NDAs, other than to outline some basic expectations as to fairness and suitability of the NDA to a student project.

Sponsor Acknowledgements:
By way of background, Purdue University professors who have senior capstone class projects involving outside sponsor companies notify our office so that we can prepare an acknowledgement form for the sponsoring company's completion. This is not a contract but an acknowledgement form signed by sponsoring companies which lays out Purdue's guidelines regarding class projects and outside company inputs, potential export control issues, and student intellectual property. Some sponsoring companies offer a monetary donation to the project, but that is not a requirement.