

Lab 1

CS 411W – Fall 2021

Inclusive Classroom – Team Gold

Travis Bennett, Dalton Hanbury, Greg Hubbard, Colton Hurst, Randy Layne, Grant Ralls

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1. Introduction

Young underprivileged students are adversely affected by having to learn online because of a lack of stable high-speed Internet and because they lack the knowledge and support at home needed to adapt when the Internet fails.

School systems were forced to adapt to new styles of teaching due to the COVID pandemic starting around April of 2020. While colleges have been using resources for online learning for decades, grade schools are not so fortunate. The shift in teaching style is affecting students' ability to learn. Younger students are struggling the most with the shift to virtual or hybrid learning. If the student encounters a technical problem, there isn't much they can do about it. The student will likely ask their parents, who might lack the troubleshooting knowledge to fix the problem.

The next course of action is to contact the teacher, who, like the parent, likely lacks the skill necessary to deal with a technical issue. The other half of the problem is the lack of stable high-speed internet access at home for lower income families. Roughly 40% of students from low-income homes must complete their homework on public internet connections. These connections tend to have slow connections when many people are on at one time, and frequently there is a time limit as well.

A young student relies on their parents or a guardian to take them to public places, which might not always be possible. The solution is a student facing app and a teacher/admin app called Inclusive Classroom. The student view will have a simple UI that is designed for children. It will be a native app so that it can run without needing internet access. The student software will have a high level of automation, such as uploading and downloading files, and zipping and unzipping files to make things as easy for the student as possible. The teacher view will not need to be

constrained to a certain device since a teacher will likely have good internet access at work.

Teachers will be able to log in on any device via login and password. The teacher interface will be designed with convention over configuration in mind to keep things simple for the student.

Below, we showcase the simple user interface logic via the Assignment Process Flow (figure 1, updated to the most current flow in figure 3). Underneath that, in figure 2, we show the process flow for uploading a video.

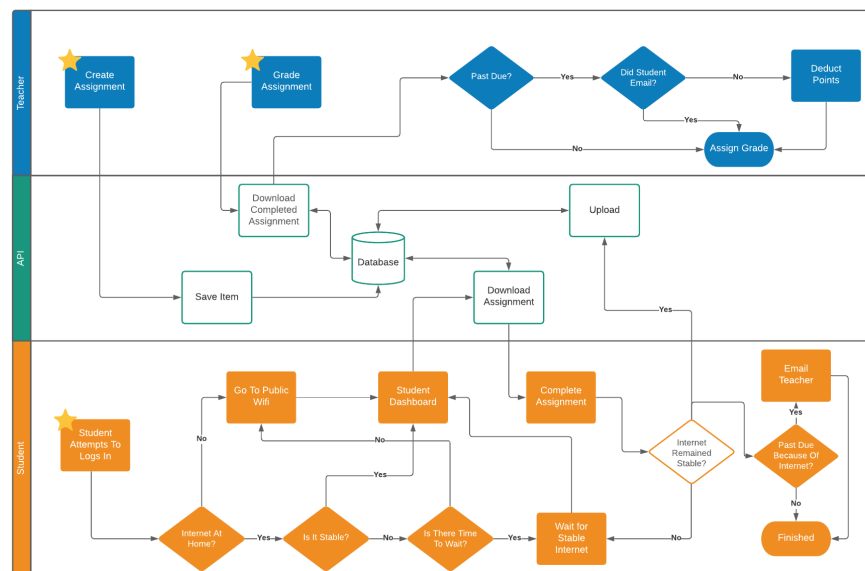


Figure 1: Assignment Process Flow

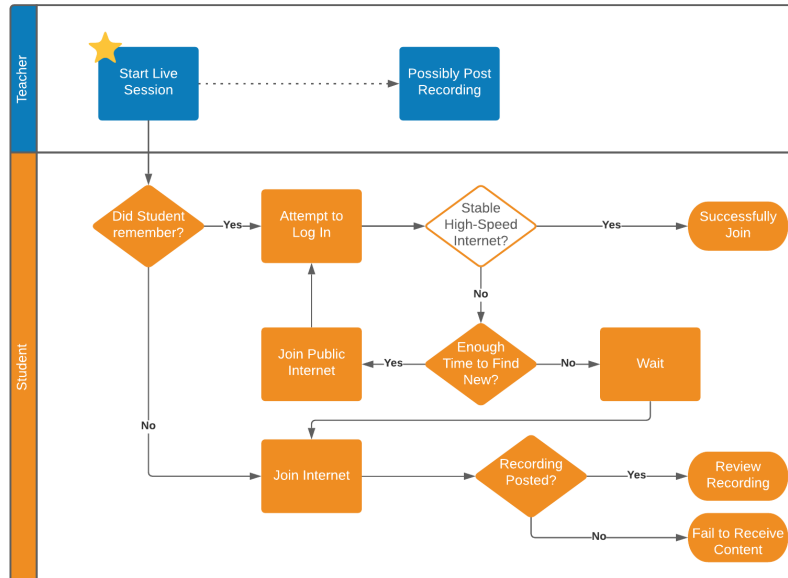


Figure 2: Live Video Process Flow

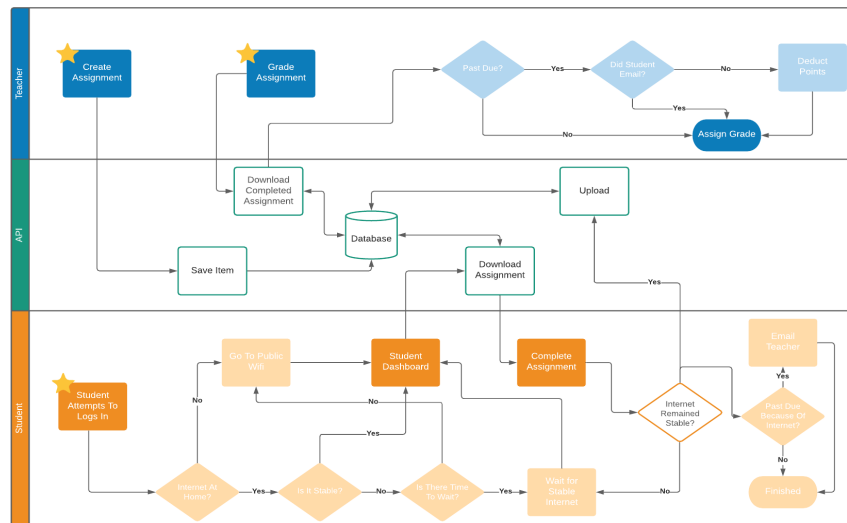


Figure 3: Current Process Flow Revisited

2. Inclusive Classroom Product Description

Inclusive Classroom's (IC) primary goal is to increase the accessibility of online learning to low-income students. Our solution is a two-pronged approach. The two primary sections will be the student-side flow and the teacher-side flow. The student side will have the ability to passively download and upload, both assignments and lectures. We will also be attaching a timestamp to completed assignments to enable teachers to determine whether or not an assignment has been completed in time. The major goal of the teacher-side flow will be to allow the teacher to interact with these students with as little headache as possible. This will be done by automating processes for uploading lectures and sending notifications of live stream status to students. The teacher will also be able to easily review the timestamp associated with the assignment.

3. Key Product Features and Capabilities

The Inclusive Classroom (IC) software will have key features and capabilities that distinguish it from the rest of the competition. The biggest concept behind IC is the idea that many students learn in environments without stable internet connections. The client app of IC will be able to operate completely without the internet. As long as the software is set up by the school or parent(s) with internet access, the student can, in theory, go the entire year without internet until the last day. All teaching materials can be prepared beforehand, and the software will manage all submissions, lectures, etc. to keep the student on pace. If the student can access the internet intermittently throughout the year, the software will automatically synchronize with

the backend server, submitting the assignments as if the student had submitted them with internet access the entire time.

At the beginning of the school year, teachers will be able to plan out the entire year, including all lectures, assignments, quizzes, exams, class updates, etc. When the student client software is first set up, it will load all of the preplanned data and manage it on the client-side. The student will then be able to follow through with the class however the teacher-designed it. They will be able to watch the lectures at their own pace, or a pace deemed by the teacher. They will be able to complete assignments as they open (weekly, for example), submitting them with or without the internet. In this way, as the internet is not required through the year, there will be no degradation in student experience; the software will allow students in areas without internet access, or limited internet access, to learn effectively. Even if the teacher can't plan out ahead of time for the whole year, even the ability to add in assignments on a weekly basis will help students with limited internet access to still be able to get their needed assignments.

The software will also be available on nearly all operating systems and computers. It will support Chromebooks, as well as the main three operating systems, Windows, Mac OS, and Linux. By supporting these, IC will be an option for nearly all school systems across the United States.

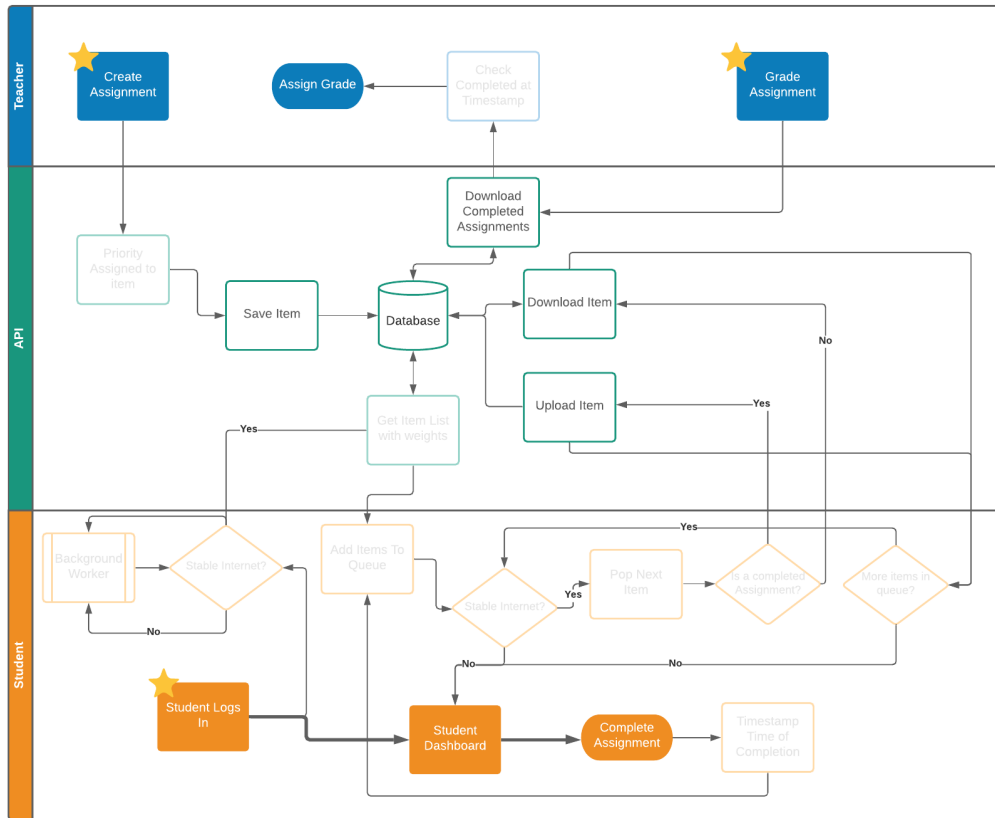


Figure 4: Solution Process Flow: Assignments

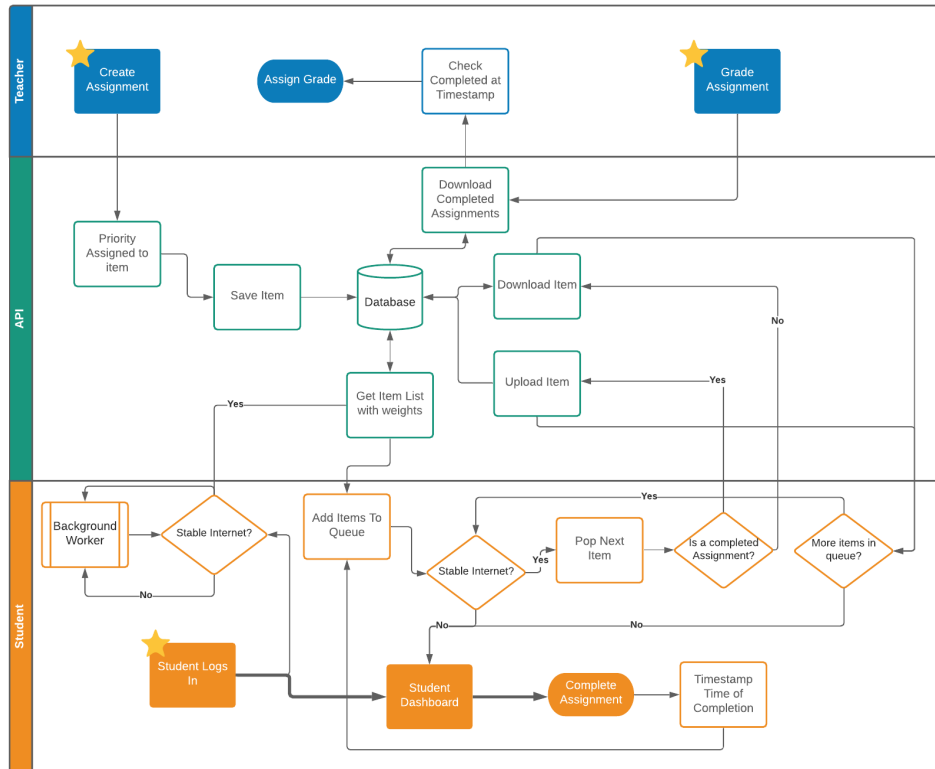


Figure 5: Algorithms Process Flow

4. Major Components (Hardware/Software)

- Required Hardware
 - Client App: Windows 10/Mac/Chromebook
 - API: Amazon Web Services' S3, Docker, and Kubernetes
- Software to be developed
 - Client Application
 - The Client application will serve as an interface between the user and the API.
Both the student and the teacher will utilize the client app. Each user type will have to authenticate.
 - We will be developing a React Native (Android/iOS) application with a SQLite store to do the following...
 - View Live Streams/Recordings
 - Record/Upload Live Streams
 - Download/Upload Assignments For Teachers and Students
 - Manage Classes
 - Assign/Upload Grades for Assignments
 - API
 - Be built with Node JS, Express, Postgres, and Redis
 - Save videos to the database
 - Be a gatekeeper to a user who would like to download a video from the database
 - Upload/Download Assignments
 - Get assignment lists as a priority Queue

- Handle user authentication
- Send Push notifications

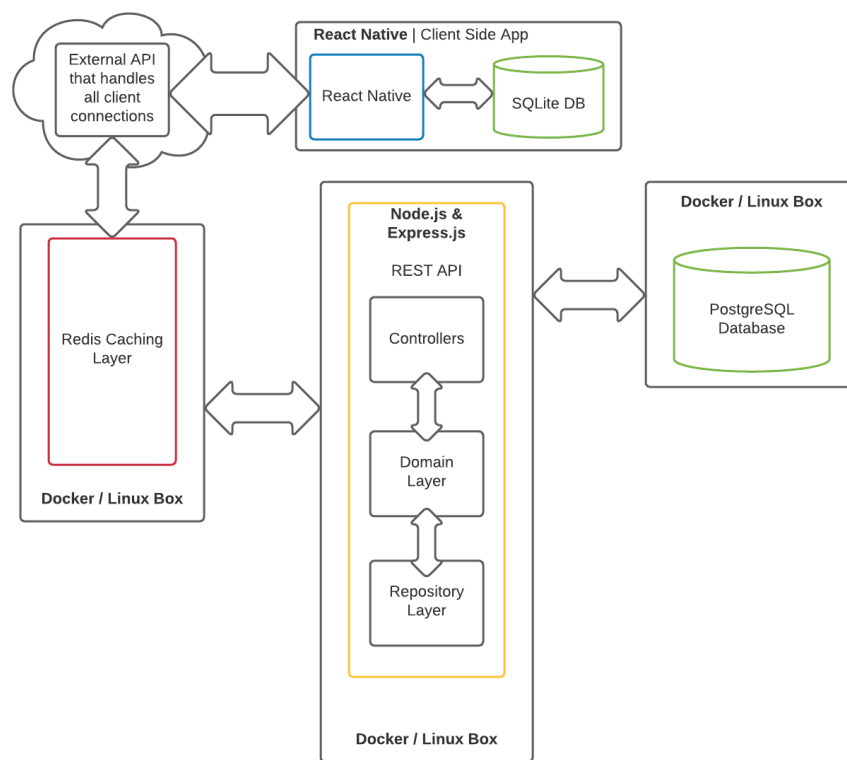


Figure 6: Major Functional Component Diagram

5. Identification of Case Study

- Inclusive Classroom is being developed for...
 - Low income students who do not have access to stable and reliable internet.
- Inclusive Classroom will be used for...
 - Live Streaming, Viewing, and Recording Lectures
 - Uploading, Downloading, Timestamping, and Grading Assignments
- Who else might use Inclusive Classroom in the future?
 - Families who want a fallback mechanism in the possibility of faulty internet.

6. Product Prototype Design

The prototype design will include most of the core features of the overall design.

Emphasis placed on the automation aspects of the proposed solution

- a. Weighted priority queue for downloading assignments
- b. Automatic detection of the Internet
- c. Automatic submission of assignments when Internet access is detected.

Visually, the prototype will implement the views necessary to demonstrate the core automations

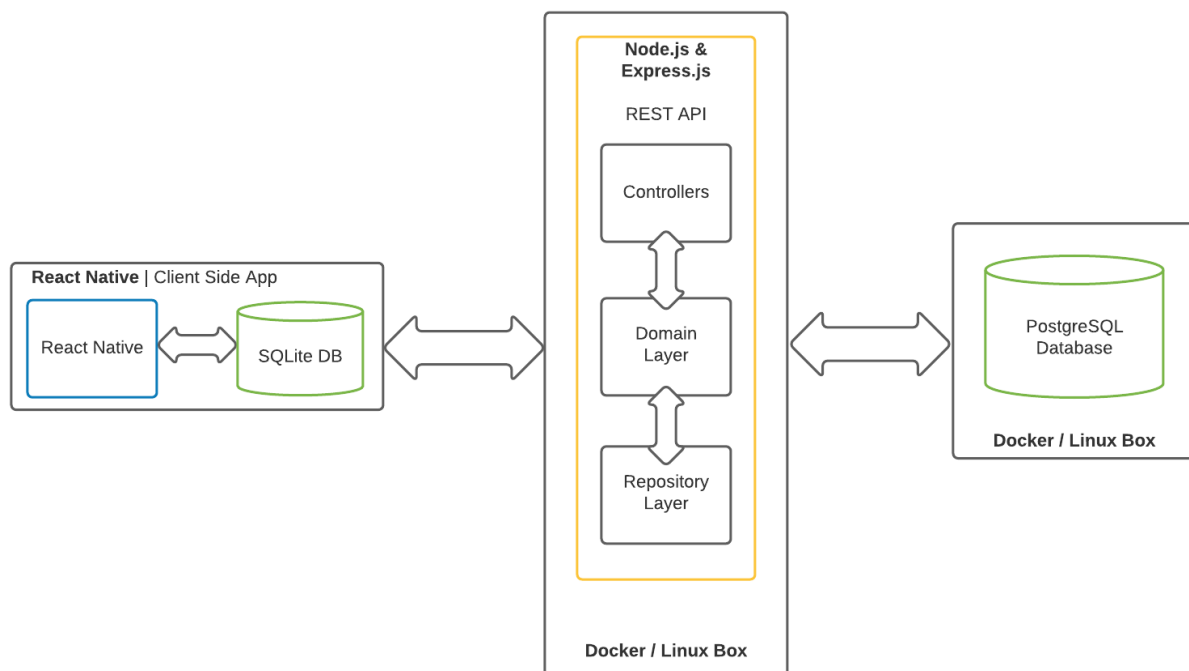
- a. Student Dashboard
 - i. Emphasis on displaying current assignments and video links
- b. Teacher Dashboard
 - ii. Emphasis on links to creating assignments, grading, and starting video sessions
 - iii. Simplified for prototype with static blocks representing non-implemented functionality.

- iv. No reporting in prototype
- c. Login screen
- d. Assignments
 - v. Limited types of assignments
 1. Homework and possibly quizzes. *No exam types in prototype.*
 2. Multiple choice and True False style
 3. Short answer questions
 4. *No Essay or upload of external files for prototype.*
 - vi. Create
 - vii. Complete
 - viii. Submit
 - ix. Grade
- e. Video conference screen

The technology used to construct the prototype will be the same as the real world counterpart.

Feature	RWP	Prototype
Account Roles	Student, Parent, Teacher, Admin, IT	Student, Teacher, Administrator(limited) only
Automatic Internet Detection	Yes	Yes
Background Workers	Yes	Partial
Complete/Submit Assignments	Yes	Yes

Create Assignments	Yes	Yes, limited in types
Grade Assignments	Yes	Yes
Postdate created content	Yes	No
Recorded Videos	Yes	Yes, may not auto record
Reporting	Yes	No
Timestamp Completed Assignments	Yes	Yes
Video Conferencing	Yes	Yes
Weighted Priority Queue	Yes	Yes



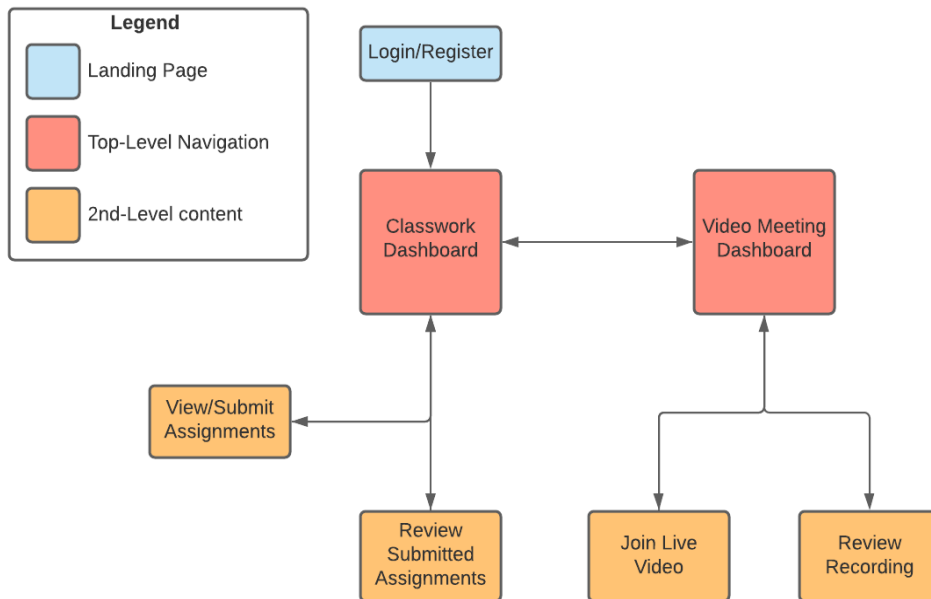
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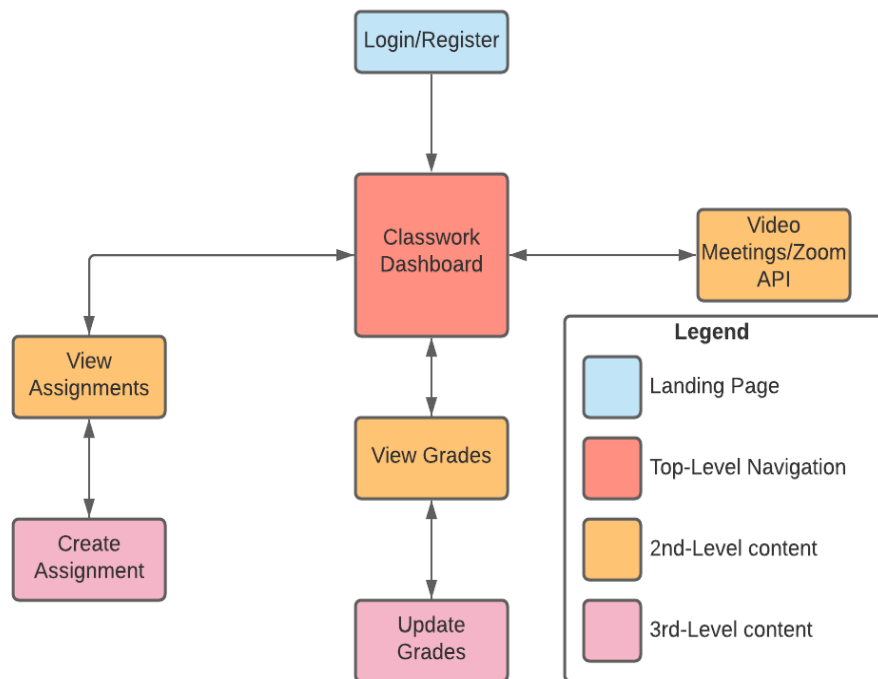
Prototype Features and Capabilities

- Teachers and students will be able to create accounts and login.
- Teachers will be able to create classes and add students to classes.
- Students will be able to view the classes they are in.
- Teachers will be able to create assignments.
- Students will be able to view their assignments and submit to them before the due date.
- Teachers will be able to schedule and open zoom sessions for students to join.
- Students will be able to watch a lecture live or watch the recording after.

Student Site Map



Teacher Site Map



Risk Matrix			Impact				
			Very Low	Low	Medium	High	Very High
			1	2	3	4	5
Probability	Very High	5					
	High	4					
	Medium	3		C3			
	Low	2					
	Very Low	1				C1 C2	C4

Student Privacy: (C1)

Mitigation: Student data will only be available to the administrators that absolutely need it, and teachers can request permission for student data if needed. Teachers and school administrators will need to go through privacy training to follow FERPA guidelines.

Teacher Privacy: (C2)

Mitigation: Teacher data will only be available to the administrators that absolutely need it, and teachers can request permission for teacher data if needed. Teachers and school administrators will need to go through privacy training, and sign waivers to be recorded during lectures.

Missed or Ignored Reminders and Due Dates: (C3)

Mitigation: The Inclusive Classroom software can include an 'acknowledge' button that proves a student and/or parent, via email or the UI, has seen an announcement, due date, or other important piece of information.

Poor English: (C4)

Mitigation: Inclusive Classroom will be English only, but for students in ESL, a section of the UI can be translated to their selected language so that they can access ESL support through their language.

Risk Matrix			Impact				
			Very Low	Low	Medium	High	Very High
			1	2	3	4	5
Probability	Very High	5					
	High	4					
	Medium	3		T3		T2	T1
	Low	2			T4		
	Very Low	1					

Loss of internet during stream: (T1)

Mitigation: Flag session as unseen and automatically downloaded recorded version when internet is restored. Optionally, notify the teacher so they can follow up with the student for any extra help needed.

Loss of Internet in mid file transfer: (T2)

Mitigation: Automatically detect dropped packages and resend when internet is restored. A date will be stored for all file transfer attempts.

Assignments can't be sent until after due date: (T3)

Mitigation: A timestamp will be created when student completes an assignment, and this timestamp will be used when comparing the submission date to due date. This will help ensure that the student can reliably submit assignments on time without internet.

Class updates not visible to students without internet: (T4)

Mitigation: Teachers will enter the syllabus into the system before the start of the year. All assignments and dates will be cached locally on the student side. Students can then receive updates throughout the semester without internet, and class updates will cache and change whenever connected if there are updates from the server.

Risk Matrix			Impact				
			Very Low	Low	Medium	High	Very High
			1	2	3	4	5
Probability	Very High	5					
	High	4					
	Medium	3					
	Low	2			S4		
	Very Low	1				S2 S3	S1

SQL Injection: (S1)

Mitigation: Databases will be parameterized though typed parameters and careful use of stored procedures. All web components (libraries, plug-ins, web server, database server software) will be kept up to date for security patches, and input will be sanitized.

Data release: (S2)

Mitigation: Sensitive student/teacher data will be encrypted on the backend in correspondence with privacy and FERPA laws. All transferred data will also be via HTTPS.

Broken Access Control: (S3)

Mitigation: Enforcement on the server-side logins will prevent students from accessing teacher permissions. Additional tests will be made to ensure specific URLs will be "hidden" without proper authentication.

Broken Authentication: (S4)

Mitigation: Authentication will be primarily based on school provided tokenization of student logins. Student passwords will be properly formed in a secure matter. Periodic password updates will be required to ensure security.

Legal Risks

Risk Matrix			Impact				
			Very Low	Low	Medium	High	Very High
			1	2	3	4	5
Probability	Very High	5					
	High	4					
	Medium	3					
	Low	2			L4	L1 L3	L2
	Very Low	1					

Children's Online Privacy Protection Act (COPPA): (L1)

Mitigation: Children's data will be heavily protected and encrypted. Anyone with access will have to go through privacy training and access will be by "need" only. Inclusive Classroom will adhere to COPPA laws, and will only gather the minimum amount of data needed to complete our mission.

504 Plan - Children with Disabilities: (L2)

Mitigation: Each school should have a "504 team" that will support any children with disabilities. There will be a special area in the UI for any students with disabilities, so that they can receive immediate help from the support team.

Litigation Risk: (L3)

Mitigation: Terms and conditions will be written up with legal support, and anyone using the software will have to agree to the terms. The goal will be for these to keep the company, the school system, and the students safe.

Contract Risk: (L4)

Mitigation: Any contracts that are drawn up will be reviewed and checked by the Inclusive Classroom legal teams. They will need to be audited to ensure that Inclusive Classroom can honor them while still achieving its goal.

1.1. Prototype Development Challenges

- Time constraint to the length of the course.
- Learning new technologies and frameworks required for implementation.
- Time learning and possible funding spent to set up CI/CD for deployment with docker containers.
- Trying to emulate a school chromebook setup as much as possible.
- Testing on various other operating systems. (Mac/Windows)

7. Glossary

1. High-speed Internet - Internet with consistent download speeds of at least 3.8 Mbps (Zoom)
2. English as a Second Language (ESL)
3. Family Educational Rights and Privacy Act (FERPA) - Federal law that protects the privacy of student education records

4. Google Classroom - “Free web service developed by Google for schools that aims to simplify creating, distributing, and grading assignments” (Google)
5. littleLearners - Former CS 410 group solution that emphasises simple UI for students in the K-5 age range (Del Razo)
6. Stable Internet - Internet with less than 1% dropped packets (ICTP)

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