Lab 1 - Inclusive Classroom

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1. INTRODUCTION

Highlighted by the COVID-19 pandemic, comprehensive distance learning has been a growing educational objective. While there are definite benefits to distance learning there are clear logistical pitfalls. According to the department of education, over 50 million K-12 students participated in mandatory distance learning. Of these students, underprivileged families are particularly disadvantaged as they may lack the resources to adapt to remote education. According to a 2020 survey, 59% of Low-Income Students face issues with online school assignments. These issues are strongly related to a lack of high-speed internet connection and reliable internet connection. Compounding these issues, the United States is currently facing a laptop shortage which has forced students to use unfamiliar technology for remote education. The solution to this pressing issue is an application called Inclusive Classroom. Inclusive Classroom is a teacher/admin app that provides ease of use for both students and teachers. On the student side, there will be a high level of automation that takes advantage of internet when it is available. When internet is available, operations such as uploading and downloading files, and zipping and unzipping files will be automatically queued. The teacher view will operate similarly to the student view to ensure that the teacher fully understands the student perspective. Convention over configuration will be kept in mind to ensure ease of use for both the student and the teacher.
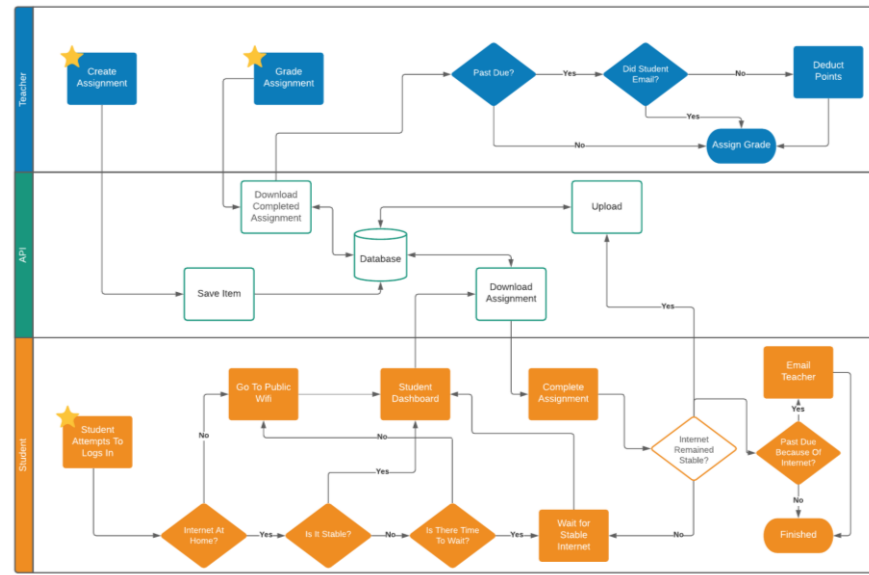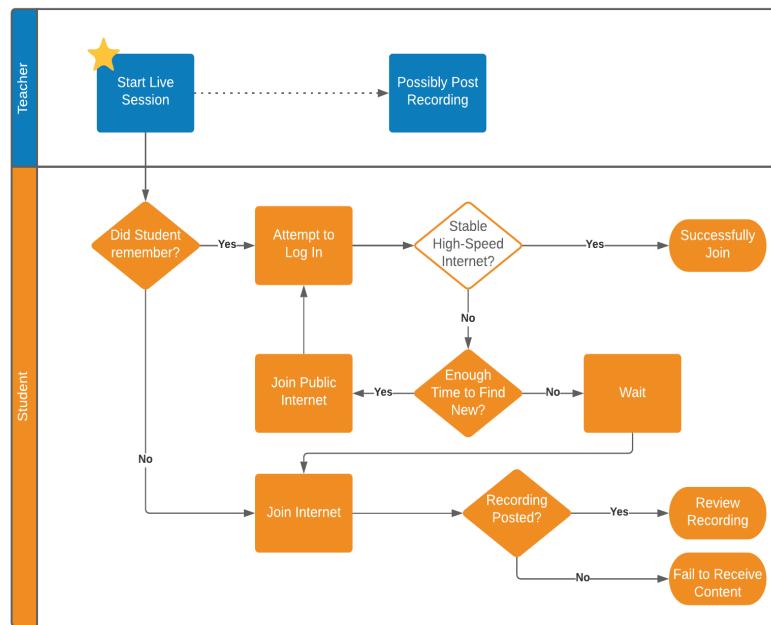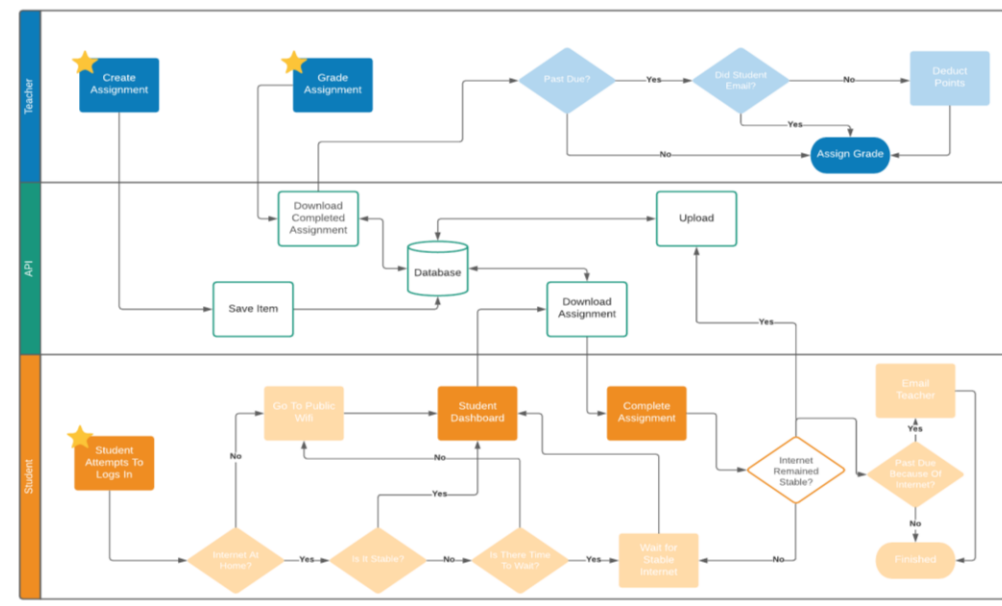
FIGURE 1

FIGURE 1: ASSIGNMENT PROCESS FLOW

FIGURE 2

FIGURE 2: LIVE VIDEO PROCESS FLOW

FIGURE 3

FIGURE 3: CURRENT PROCESS FLOW REVISITED

2. INCLUSIVE CLASSROOM PRODUCT DESCRIPTION

Inclusive Classroom (IC) functions to promote the accessibility of online learning to disadvantaged students. This application features both a student-side and the teacher-side flow. The student side will seamlessly coordinate the downloading and uploading of both assignments and lectures. Submitted assignments will be "tagged" using local device timestamps to ensure timely delivery notification regardless of internet availability. The teacher-side flow is modeled against the student-side flow to ensure teachers understand student interface. Additionally, the teacher will have the ability to automate the notifications sent to students to allow for comprehensive communication.

2.1. KEY PRODUCT FEATURES AND CAPABILITIES

Compared to competition, Inclusive Classroom (IC) offers features that distinguish itself in its use case. Primary this use case is to target situations of poor or unstable internet connections in remote learning. On the client side, IC will be entirely operational without internet connection. Assuming that the teacher posts all content on the first day of school, the student would theoretically be able to operate completely without the internet. On the teacher side, the instructor can upload all of their content including submissions, lectures, and recordings in a streamlined fashion. If the student has the opportunity to synchronize with internet connection, their work and progress will be uploaded to the backend server.

To account for as many student situations as possible, Inclusive Classroom will be widely available on different operating systems and computers. Most notably, Inclusive Classroom will be designed in consideration of Chromebooks. Chromebooks are currently the most widely

distributed school issue devices. Windows, Mac OS, and Linux will be supported in order for
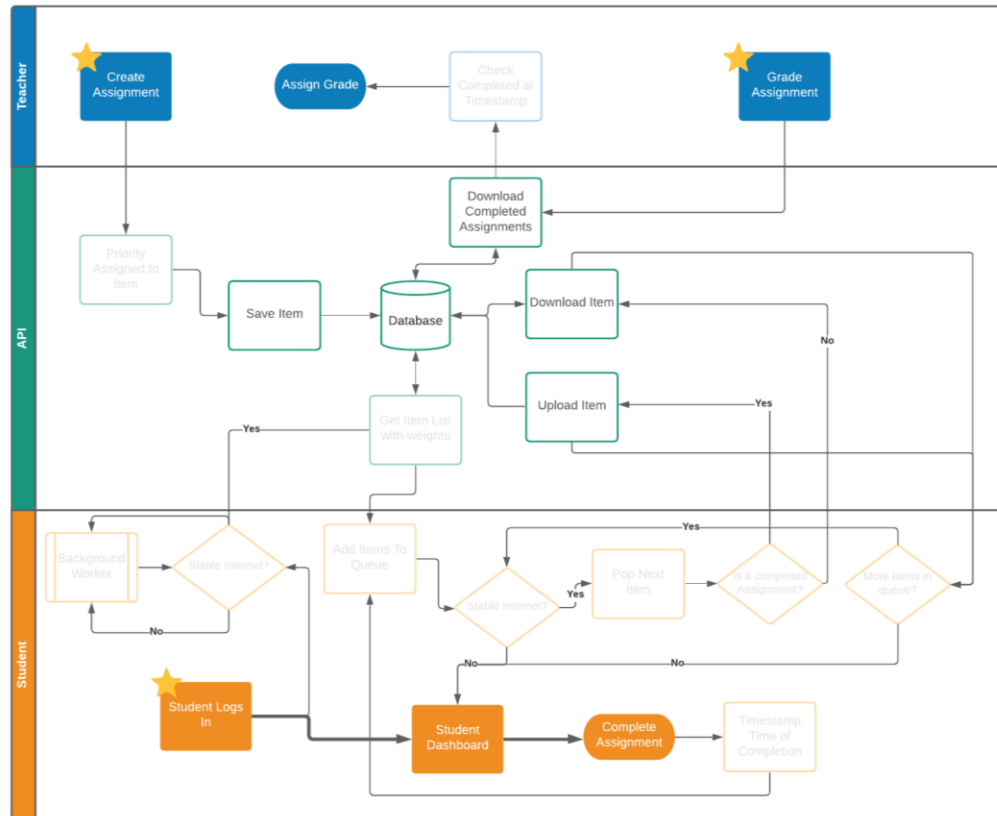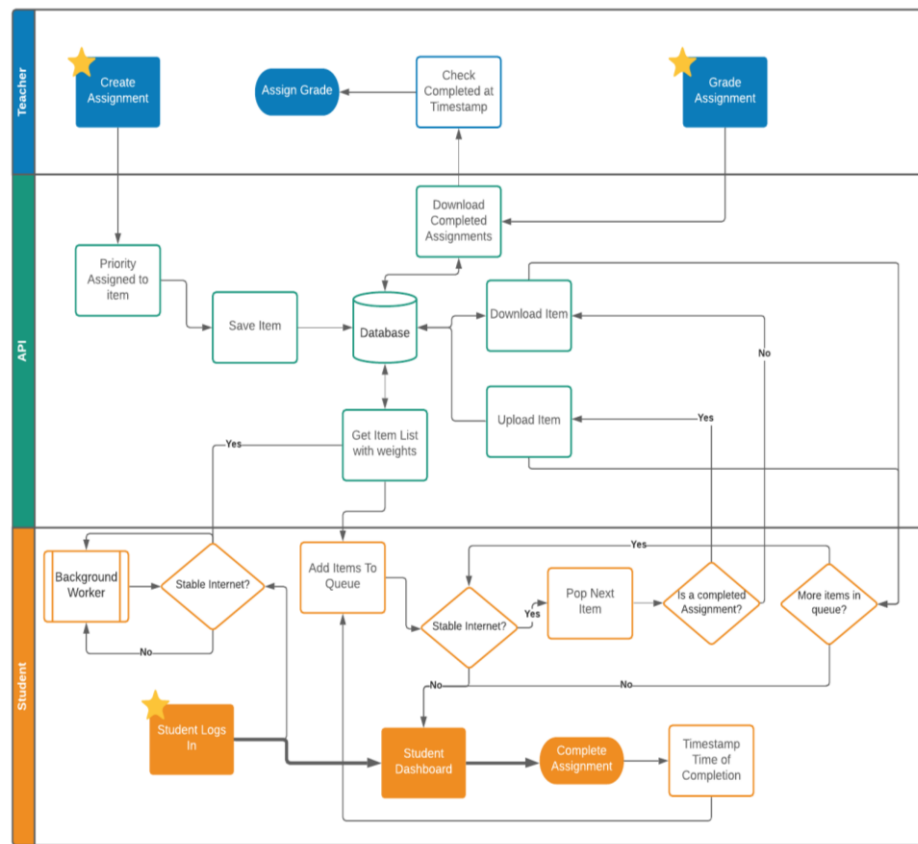
operation in nearly every school system.

FIGURE 4


FIGURE 4: SOLUTION PROCESS FLOW - ASSIGNMENTS

FIGURE 5

FIGURE 5: ALGORITHMS PROCESS FLOW

2.2.   MAJOR COMPONENTS (HARDWARE/SOFTWARE)

Inclusive Classroom consists of both a student client interface and a teacher client interface. Personal devices running Windows 10/Mac/Chromebook will be supported on the client app. The following API will be supported Amazon Web Services' S3, Docker, and Kubernetes.

The client application will operate as a direct interface between the user and API. Using React Native (Android/iOS), the application will take advantage of a SQLite store to view live streams/recordings, record/upload live streams, download/upload assignments, manage classes, and assign/upload grades for assignments.

The API will be built with Node JS, Express, Postgres, and Redis. There will be functionality to save videos to the database. This API will also gatekeep who and when users can download the stored videos. Assignments will be managed in a priority queue where push notifications will be procedurally sent according to set due dates. The retrieval of assignments will be handled by an user authenticator.

FIGURE 6
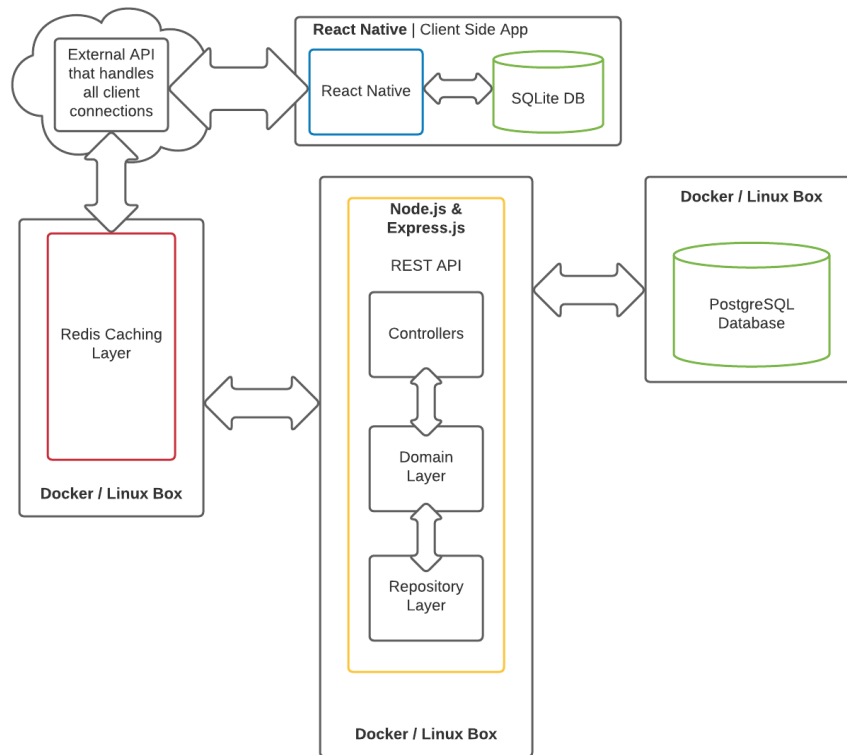
FIGURE 6: MAJOR FUNCTIONAL COMPONENT DIAGRAM

3.   IDENTIFICATION OF CASE STUDY

Inclusive Classroom is intended for use by low-income students who do not have access to stable and reliable internet. The target student demographic is between the K-12 level with aims at the younger grade levels. Inclusive Classroom will provide live streaming, viewing, and recording lectures given sparce internet connections. On the instructor side, teachers will be able to monitor and foster education without specific meeting times. Teachers will be able to upload, download, grade, and view timeliness of student activity. In the future, Inclusive classroom may be used as a fallback for students in crisis or in abnormal school situations.

4.   PRODUCT PROTOTYPE DESCRIPTION

The prototype of Inclusive Classroom will function in a similar manner as the real-world product. The prototype will emphasize the student, teacher, and administrator views. Fundamental aspects of the application such as automatic internet detection, manipulation of assignments, distribution of lectures, and time stamping will be strongly representative of the final product. An emphasis of automation will also be highlighted as a key aspect of the proposed solution. Features such as weighted priority queues, automatic internet detection, and automatic submission of assignments will underline the prototype's foundation. Some cosmetic features will be left out of the prototype to allow a greater focus on the application rather than the UI.

4.1.   PROTOTYPE ARCHITECTURE (HARDWARE/SOFTWARE)

The prototype of Inclusive Classroom will use the same fundamental hardware and software as the proposed real-world product. The Client App will be designed with windows 10/Mac/Chromebook hardware in mind. The API required will include, Amazon Web Services', S3, Docker, and Kubernets.

The required software for the client application will supplement as an interface between the user and the API. Because both the student and the teacher will utilize the client app, there will be authentication and security measures in place to ensure admin permissions are restricted. React Native (Android/iOS) will be used to develop the client application. This software will be used to create functions for live steams/recordings, downloading/uploading assignments, manage classes, and assign/upload grades. Additional software API features will be needed to manage database communications and send user notifications. These API will be built with Node JS, Express, and Postgres.

FIGURE 7
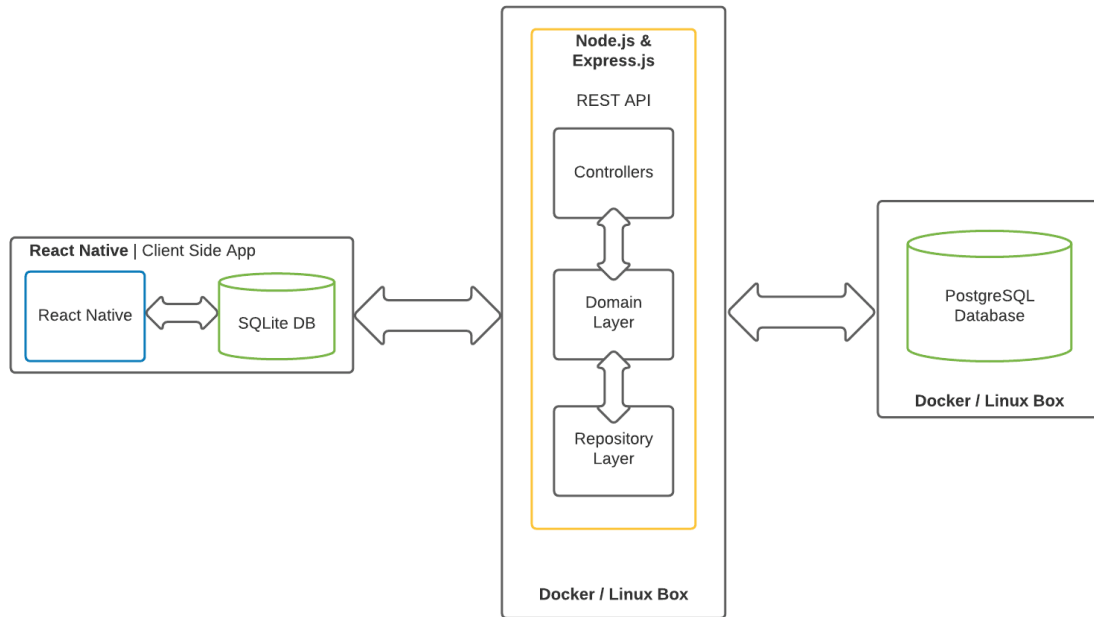
FIGURE 7: REVISED MAJOR FUNCTIONAL COMPONENT DIAGRAM

4.2.   PROTOTYPE FEATURES AND CAPABILITIES

The prototype for Inclusive Classroom will include differences from the final public release. Component wise, the prototype will include all major automation and interface capabilities required for backend operation. Table 1 below outlines the discrepancies.

Table 1

Inclusive Classroom Real World Product v. Prototype Table

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

4.3.   PROTOTYPE DEVELOPMENT CHALLENGES

The lack of real-world data will pose a challenge for the development of Inclusive Classroom. While there is ample research surrounding our design considerations, a lack of physical student interactions may pose unpredictable issues. Real-world issues may be overlooked in the technical aspects of application development. Open communications with known educators and teachers may ease the process as the final product is developed.

5. 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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