

Studios - dedicated e-learning platform

Scientific Report

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Abstract

Due to the sociopolitical climate of past 2 years, a need in better education across distance has been imposed as an important milestone for the future. Studios as a solution comprises as a quick response to the shift in the educational acts as a direct result of the effects of the past global pandemic. The dominant solutions for e-learning are exceptional in their respective fields but they lack in generality and cohesion. Most learning institutions require multiple platforms to be able to function at maximum capacity. In this study we propose to investigate the feasibility, scalability and portability of the proposed solution making used of a few architectural inner workings to justify its uses and advantages of working with.

1 Introduction

Studios as a solution comprises a response to the current shift towards online education due to the aggravating effects of the past but still relevant COVID19 epidemic. Although considered a short-term replacement for the more traditional schools, there is a plethora of opportunities still left for the prospect of online schooling. According to this perspective, this is the place Studios fits in, the platform's end goal is to develop an integrated solution to offer professors and students alike the means to make learning and studying off-site fast and agreeable.

1.1 Goals

- Ease of use. The platform's prime intention, is to make learning fast, easy and accessible, to nurture the educational act in a cohesive and friendly manner to everyone whether of their technical background.
- Scalability. The platform should be undeniably capable to handle hundreds if not thousands of concurrent users.
- Low downtime and proper issues mitigation. The platform should offer the aforementioned functionality at the best of its abilities and without discounting quality, ranging from reliable services to security and data encryption to low downtime and frequent feature improvement and issues mitigation.
- Portability, the users shouldn't be denied whether their use whether they are on iOS, Android, or Windows.

2 Technology stack

Studious as stated previously, is class management comprised of two major component: system for managing classes, students and documents associated with the aforementioned classes via a Restful API and a fast and reliable peer to peer video chat communication system based on WebRTC.

To provide the mentioned functionality the platform makes use of a number of services from a number of cloud providers such: Amazon, Google, Heroku. In the next paragraph, a short description of the used services will be given to dive deep at a later time into the intricacies of the back-end services of the platform.

A few of the **cloud services** and SaaS platforms that makes everything possible are as follows:

- Heroku
- Github Actions
- Amazon Elastic Computing
- Amazon Elastic Repository
- Amazon S3
- Amazon CloudWatch
- Amazon Lambda Function
- Google STUN

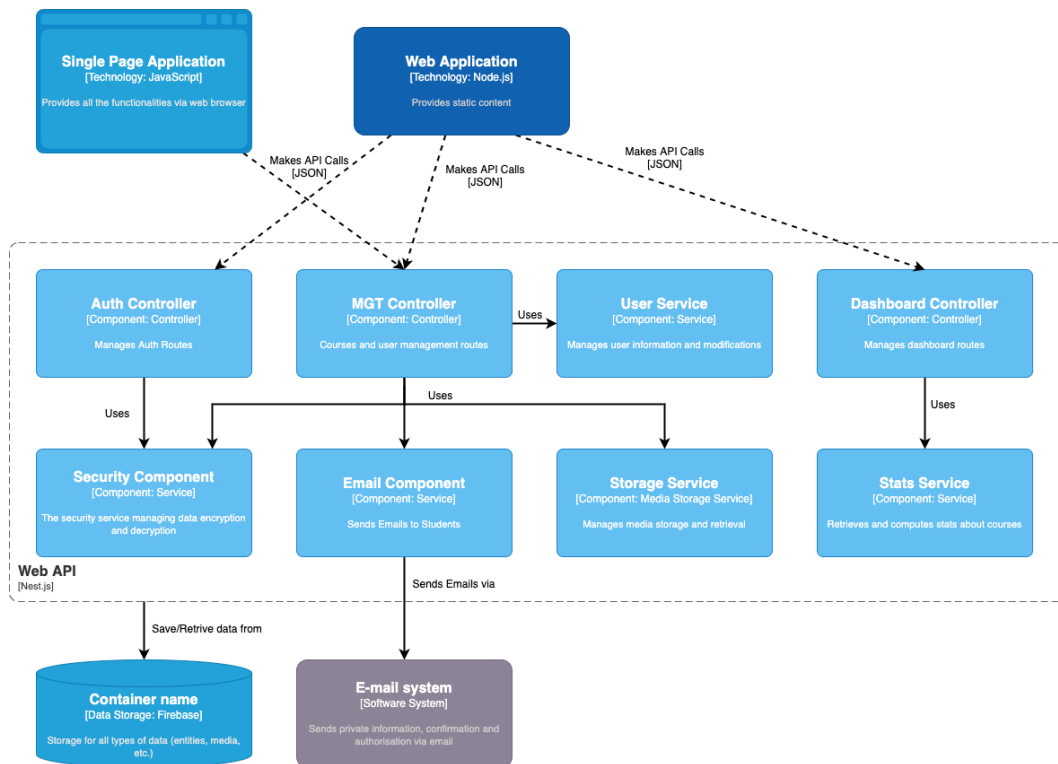
A few **technologies** other than cloud services that makes everything possible are as follows:

- NestJs
- Typescript
- PeerJs
- Mongo Atlas
- JQuery

2.1 Restful Back-end API

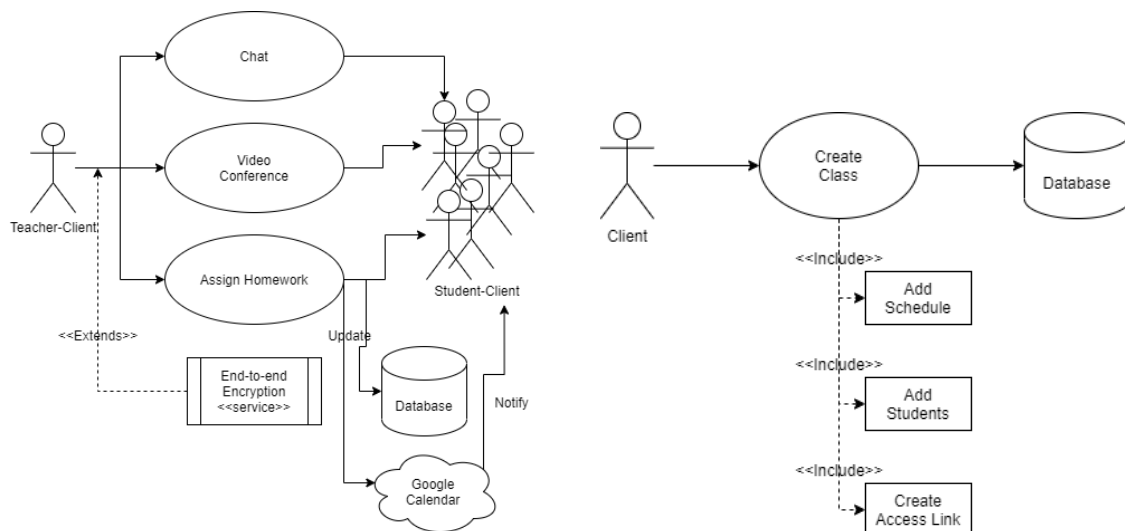
The central place of the infrastructure, it is occupied by a single Restful API written in NestJs which manages the events inside the system such as: classrooms management, homework management, registration and authorization, reminders and notifications, etc.

In order to have a fully available API service to the client but also to the front-end, the API is deployed via a workflow of CI on Github Actions to a Amazon Elastic Computing container using a built docker image inside a Amazon Elastic Container Repository. This contributes to the reliability and availability of the application with the consideration to the workloads and prospects required on managing an on-premise server for the API, also it ensures that the application has the minimum downtime due to infrastructural problems.



For the scope of data storage **Amazon S3** offers a reliable long-term bulk storage for documents and such and also exposes proper and fast methods for retrieving the stored data. The Studios platform uses this functionality in order to store reliably documents related to classrooms such as assigned tasks. S3 is a general available solution for data storage and is being used by a plethora of companies to different extents, companies such as: Netflix, Airbnb, Spotify, Udemy.

For the scope of notification and reminders **Amazon CloudWatch** and **Amazon Lambda** functions are being used. On an interval of 24 hours prior to a task's designated completion period a student in its joined classroom will receive an email. The mechanism this functionality relies upon is using CloudWatch to trigger a function running a certain logic for sending email to all the participants in a classroom.



2.2 Continuous Deployment and Continuous Integration

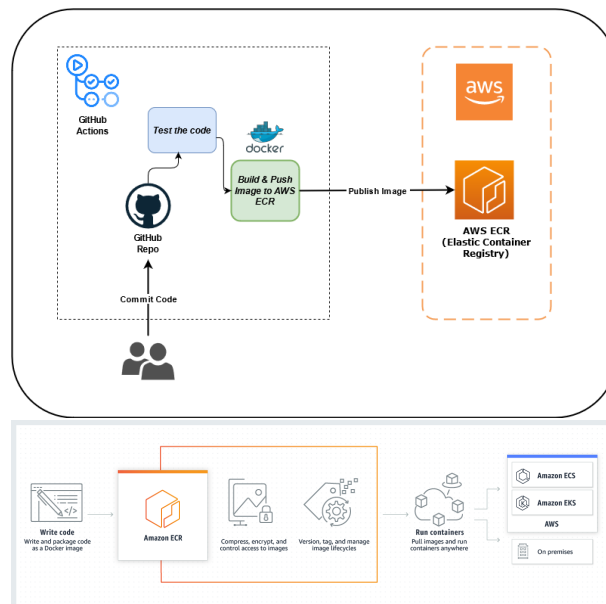
As stated earlier one of the important aspects and also a previously self-imposed goal of the platform is low downtime and high quality of service. To achieve this goal we have to define a proper pipeline for the code to be delivered as soon as possible and as reliable as possible to the client by being automatically collected from our own repositories and spun to one of the instance hosted on an associated cloud provider such as Amazon.

Continuous deployment (CD) is a strategy for software releases wherein any code commit that passes the automated testing phase is automatically released into the production environment, making changes that are visible to the software's users.

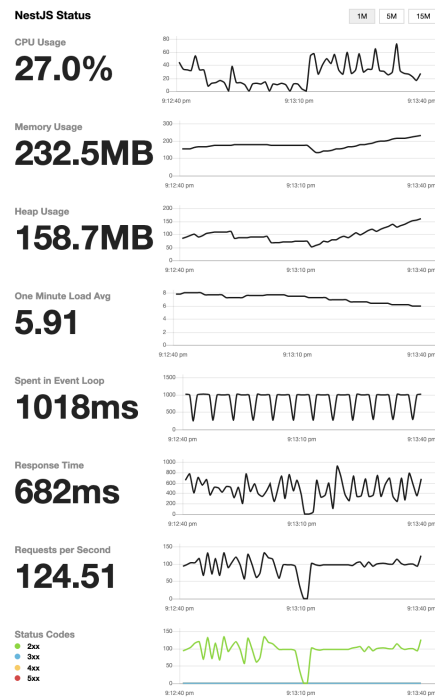
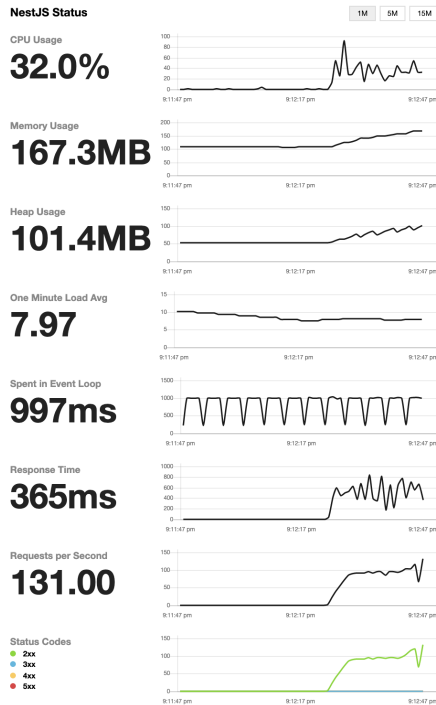
Continuous integration (CI) is the practice of automating the integration of code changes from multiple contributors into a single software project. It's a primary DevOps best practice, allowing developers to frequently merge code changes into a central repository where builds and tests then run.

These subjects are relevant to the platform since a proper workflow of CI and CD makes it possible to have minimal downtime due to upgrade to the underlying architecture but also deliver functionality with as little defects as possible.

Github Actions is one of the platforms that offers the possibility to compose such CD and CI pipeline. Used by companies such as Gannett, FireEye, actions offers a simple API to configure how and which conditions your code it is built, tested and delivered to the productions medium.



3 Results



Monitoring is a very important aspect to ensure maximum availability of a service to the user. Health Checks are a good way to assess the availability status of a service or an application. NestJs provides the tools for this purpose.

We are able to check hardware performance metrics like CPU usage, Memory usage, Heap usage. Additionally we have access to on minute time to load that denotes the maximum loading times for all the requested pages by clients. Furthermore in the temporal checks we also have loop time and response times, were we can see how well is the server facing for loads of over 130 users connecting at the same time.

The most useful feature of the live monitoring is that disposition of status codes can be observed in real time and can be addressed as soon as possible in case of an emergency, what is more we tracked how well the app executed after it was strain tested against different

4 Comparisons with similar products

Google Classroom has a wide array of classroom tools for teachers and starting a video meetings, creating and managing classes, assignments, and grades online without paper. Classroom allows for tracking classwork and submit assignments. Checking originality, feedback, and grades. Teachers can add materials to student assignments, such as YouTube videos, a Google Forms survey, and other items from Google Drive, it also has direct, real-time feedback.

In comparison Studios also has a homework and task management services that allow students and teachers to track progress.

Microsoft Teams is in the top business apps used for presenting power-points with access to apps, bots and connectors, audio conferencing, standard and private channels, chat and live events and meetings. It also allows screen sharing and webinars.

Teams is a business-centric platform, while it allows a lot of customization and it can be used as a learning management system it has monetary limitation for small institution and it does have a high learning curve compared to other similar apps. While google classroom is based on a homework medium and student teacher relationship, Microsoft Teams is one of the best solution for live classes.

5 Planned future work

Currently, there are a few of improvements that needs to be done to better mitigate some of the issues that might appear as the platform matures.

- Improved security (WAF) for the users especially for the P2P communcation.
- Improved scalability through using larger clusters and load balancers.
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6 Conclusion

Studios is a solution for the present moment in our lives, design with ease of access and as a way to combine two very used methods of e-learning and class and task management. In this research paper all main points about the technology, use cases and comparisons to the state of the art have proved the necessity of an multipurpose application.