WebRTC based Collaborative programming platform for Teaching and learning.

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Abstract: One of the last major challenges for the web is to enable human communication through voice and video: real-time communication or RTC for short. RTC should be as natural in a web app as entering text in a text input. Without it, you're limited in your ability to innovate and develop new ways for people to interact.

Historically, RTC has been corporate and complex, requiring expensive audio and video technologies to be licensed or developed in house. Integrating RTC technology with existing content, data, and services has been difficult and time-consuming, particularly on the web. However since with the recent upsurge in the development of real-time communication based systems education seemed to be a left-out/misfit element. Hence we propose a real-time communication system for classrooms to enhance the interactivity of the classroom environment.

IndexTerms **- Real-time, Classrooms, Teaching, Digitization, Inclusion.**

I. INTRODUCTION

Assuring and enhancing the quality of learning and teaching has gained increasing prominence in recent years. Engaging in any quality assurance or enhancement process requires documenting evidence. Monitoring quality requires evidence. The focus of our proposed system is to gain real-time insights of students learning in the classroom and converting into a quantifiable metric of learning. Computer assisted Learning/ Technology enabled learning has an extremely limited reach. Rarely do we see a student coding in his/her DSA/OOP class, making those extremely intuitive to learn subjects a fairy tale of random imaginations. Laboratories are not beneficial with X number of programs to be mugged upon in Y amount time. Lack of live and active proctoring deprives the student from the required mentorship they deserve. Lack of acceptance of the fact that, CS is mathematics heavy subject; it requires problem solving similar to mathematics class. However answers/visualizations in coding cannot be achieved on a blackboard or a computer connected to a projector. It needs an active participation of students too in the teaching learning activity.

II. LITERATURE SURVEY

We have divided out survey into three major portions namely, Technical aspects – WebRTC, Social aspects (the classroom dynamics), and the diversity aspects. However in the later sections we would restricts ourselves only towards the technical aspects.

A. Real-time communication and the WebRTC

With WebRTC, you can add ongoing correspondence capacities to your application that chips away at top of an open norm. It upholds video, voice, and nonexclusive information to be sent between peers, permitting developers to fabricate incredible voice- and video-correspondence arrangements. The innovation is accessible on all advanced programs just as on local customers for every significant stage. The innovations behind WebRTC are executed as an open web standard and accessible as ordinary JavaScript APIs taking all things together as significant programs. For local customers, similar to Android and iOS applications, a library is accessible that gives similar usefulness. The WebRTC project is open-source and upheld by Apple, Google, Microsoft, and Mozilla, among others.

There are various use-cases for WebRTC, from essential web applications that utilize the camera or receiver, to further developed video-calling applications and screen sharing. We have assembled various code tests to more readily represent how the innovation functions and what you can utilize it for.

B. The classroom dynamics

The most frequently occurring shortcomings with respect to the present day classroom teachings can be mainly started as:

1. Lack of teamwork, empathy, and support between students.
2. Teachers working too many roles at the same time
3. Teachers being made accountable for more than they should
4. Not enough time to plan/execute a class.
5. Excessive paperwork for data collection.

The aforementioned problems are just a few among hundreds. We are not aiming to solve all the thousands of them however we would definitely try to solve the most frequent ones

C. The diversity aspects

In the context of the Indian education systems there are a few subtle points to be considered:

1. Acceptance of the usage of mobile phones during the classroom hours with an intention to improve the process.
2. The quality of computational infrastructure available in the institution/ available to students.
3. The affordability to implement the proposed system. Scalability is also a considerable aspect.

Out of the aforementioned points the first one is not in the scope of this paper however we will discuss the latter two in detail.

III. CURRENT LIMITATIONS

A. Any homeroom where the exchange of information is going on is classified "a study hall having a decent learning climate" and the other way around. Instructors have abilities with individuals. Much of the time PCs don't intrigue individual's people, as the association is dominatingly uneven.
B. Instructors don't care for shocks or disillusionments in the study hall - when they have anticipated something, it should be there. Innovation is as yet an insecure item.
C. Absence of help inside the educational system keeps individuals from posing inquiries and pushing ahead past the endurance or dominance stages. This is regularly demotivating for genuine inquiry searchers.
D. Hesitance to set aside the effort to present an Internet based movement when there are such countless different strategies for guidance which are at first more proficient.
E. Instructional objectives, educator experience, topic or educational plan zone, accessible assets and backing, and understudy needs are on the whole factors that influence instructor's innovation use. In the event that they are in the mentality of joining innovation when they plan a unit, it won't occur.
F. An excess of spotlight on introduction, brief period left for training. Since an educator needs to pass on a fixed number of thoughts inside a confined time, most homeroom practices are taken care of business to the presentation mastermind figuratively speaking. The training is left for the understudy to do as schoolwork.
G. This technique doesn't contemplate understudies to investigate various roads in regards to groundbreaking thoughts. Their learning is put to a stop at a particular stage; they wind up pressing thoughts and are unsuitable to convey anything beneficial, beside customary reactions to test questions
H. Moreover, various understudies may slow down out while doing give sets at home. This additionally discourages their display. If they are ill suited to expert one thought, and have been unsuitable to practice it effectively, we can't in any capacity whatsoever expect that them ought to understand a more exceptional thought reliant on the previous one.

IV. OBJECTIVES

A. Try to communicate the stakeholders of the pre-existing solutions to gain insights about the specific pain points.
B. To build a comprehensive full-stack platform for teacher and students to falicitate teaching and learning.
C. Building basic realtime communication tools for the stakeholders to provide an intuitive learning experience.
D. Reduce the time for to and fro communication among the users/learners.
E. Implementation of three tire architecture for each seperate feature to increase maintainability of the overall system.
F. Setting up a real time communication channel using webRTC and connection broker using Sockets.IO.

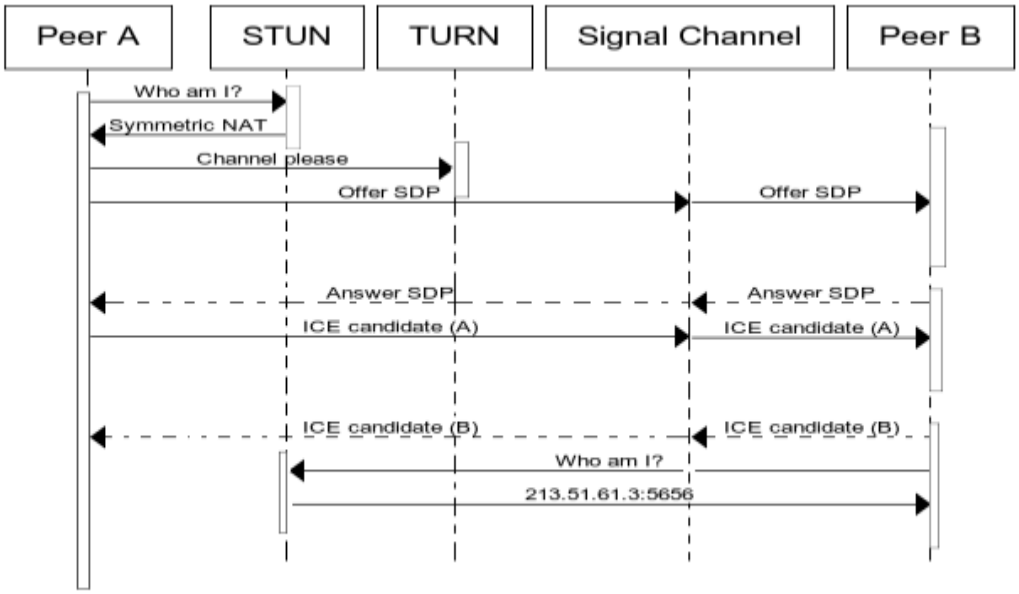
V. METHODOLOGY

The methodology used to solve the problems discussed above mainly focuses on the technical solutions for building a platform for increasing the interactivity within the classroom and henceforth increasing the productivity.
Technical discussions:

A. OAuth: Github, Gmail and School mail. This is an optional feature since it is highly dependent on third party providers to implement this for authentication.
B. Communication/Real-time connection broker: WebRTC and PeerJS. webRTC is the technology behind all of the real time communication. PeerJS helps to establish a communication channel among the group of peers (learners in our use case) and make sure the communication is durable.
C. Establishing the communication channel: SocketIO. SocketIO is a library based on webSockets. This helps to establish the communication by doing an initial handshake.
D. Monitoring of the student data/progress: Chron, ShareJS. ShareJS is a javascript library for implementing operational transform algorithm.
E. Cloud services: Mainly GCP, with some parts of microservices on heroku and netlify. Redis for message broking.
F. Database: PostgreSQL, MongoDB, AWS S3 (or secondary storage to run it locally) for persistent file storage.

VI. DIAGRAMS

A. Sequence diagram for the proposed solution



B. Use case diagram for the proposed solution

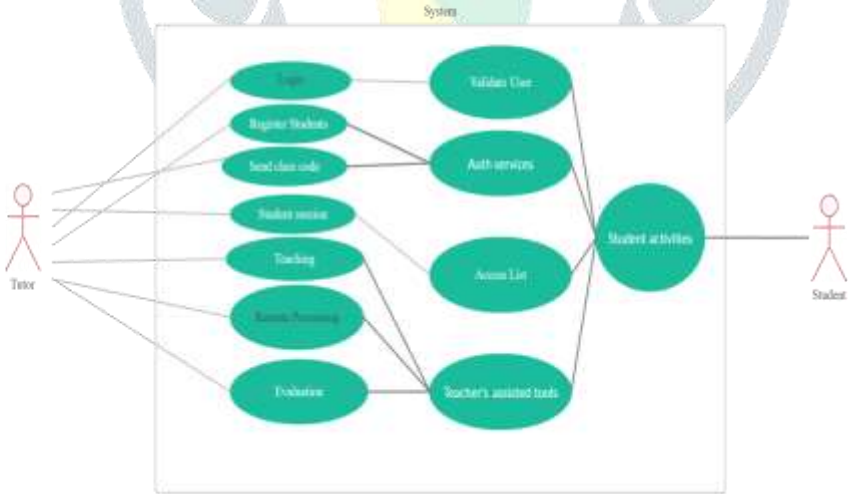


Figure2. Use case diagram
Note.The figure depicts the Use case diagram of the implemented solution

C. Architecture Diagram

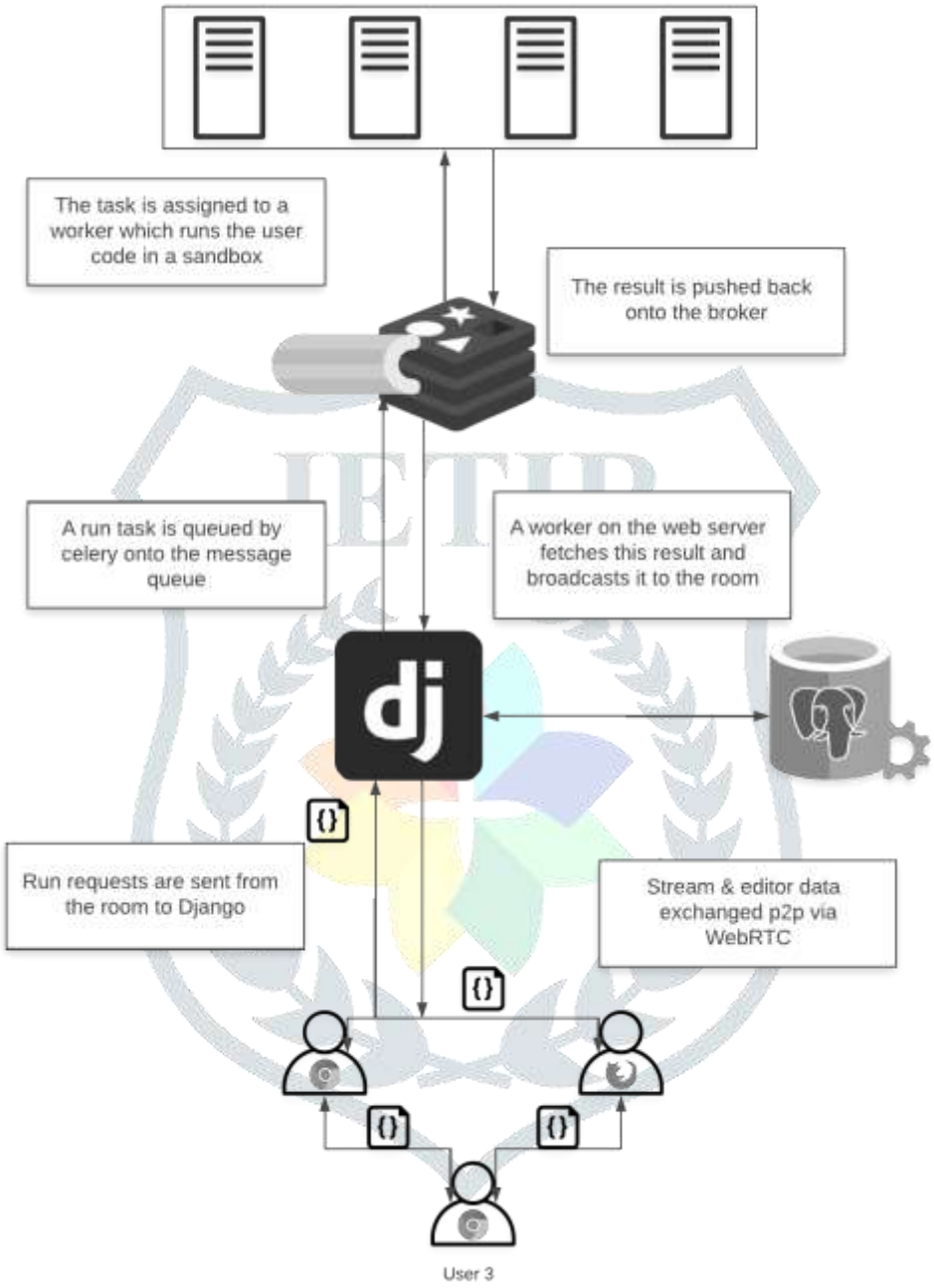


Figure3. Architecture diagram of the implemented solution

VII. RESULTS

We were able to implement most of the real-time communication requirements in an intuitive manner. Each of the separate micro service functional and worked in an expected synchronized fashion.

VIII. CONCLUSION AND FUTURE SCOPE

A. Although we were able to provide all of the basic and the minimum required features in an efficient manner however we can certainly improve our solution in following aspects:
B. Compilation time for each execution scheduled by the teacher/learner
C. Watch dog: We can implement a watch dog feature for the teachers to check out the productivity of each student automatically.

D. Increasing the number of learners in a class. Since this is a browser to browser based communication system we cannot increase the participants after a certain limits. This can be overcome using a separate server for communication stream.

E. Usage based rate limiters, in the existing solution the learners can compile the code infinitely and this may cause an overhead in the backend.

IX. REFERENCES

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