On the Requirements and Architecture of All-in-One Platform for Virtual Conferences

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***Abstract*—With the contact-free situation due to the COVID-19 pandemic, many organizations tend to host virtual events instead of conventional offline events. Since many things should be handled through the online operations, the traditional system for offline events should be re-designed to support the whole process of virtual events. In this paper, we propose an architecture of an all-in-one platform for virtual conferences. The platform provides full services required by a virtual conference which is easy enough for both IT and non-IT experts. The platform provides tailored functions and menus according to the specific size, nature, and field of an academic event. Experimental results show that the parallel upload function of the proposed architecture achieves significantly higher upload speed for sharing a presentation video after the recording ends, compared to the usual video upload function.**

***Index Terms*—Virtual event, Video conference, EDAS**

Fig. 1: Life cycle of virtual events with all-in-one platform

I. Introduction

The COVID-19 pandemic, also known as the coronavirus pandemic, has drastically changed our daily lives. The offline events such as academic conferences are also being held remotely or virtually nowadays. Recent IEEE international conferences, including the ICC 2020 [1], are providing virtual program for remote attendees, if not postponed. As the pandemic is forecast to last longer than expected, demands for a software platform that suits to the virtual events are consistently increasing. It should be noted that academic events in various fields, including psychology, literature, philosophy, and medicine, are significantly being affected by the pandemic. Therefore, an easy and integrated software platform should be developed which can provide full services required by an virtual event and is easy enough to be handled by non-IT experts.

In this paper, we propose an all-in-one platform to support various operations for virtual events as shown in Figure 1. The platform can provide event handling operations including committee organization, paper submission and review, program set-up, paper presentation, logistics, and billing within a single system. The remainder of this paper is organized as follows. In Section II, we review the existing systems for academic events. Section III specifies the system requirements and describes the architecture of the proposed platform. In Section IV we present the experimental results of key functions. Section V concludes this paper with future work.

II. Related Works

Many academic events in the fields of computer and electrical engineering utilize EDAS [2] to submit and review papers, administrate reviewers, organize committees, and manage copyrights and publications of accepted papers. As of July 29, 2020, more than 300 conferences are listed on EDAS. Duetone [3] is recently used by the virtual conferences of IEEE WCNC and INFOCOM. By utilizing Zoom [4], Duetone provides video functionalities for presenters to make videos and for attendees to participate in the technical sessions.

Although EDAS provides many powerful and professional functionalities (such as access to the scholar information maintained in IEEE database) for a conference administrator, it is hard to be used by a non-IT expert due to its fine-grained settings. Moreover, EDAS does not support video conferencing or online presentation, which is essential for virtual events. On the other hand, Duetone does not have any functionalities with regard to paper submission and review, and committee organization as well.

Since EDAS and Duetone (with Zoom) provide the complementary functions, a conference administrator should utilize both systems together for the successful operation. However, utilizing multiple systems is not easy in terms of inter-working. Due to a system mismatch, the author and paper information in EDAS is not migrated to Duetone gracefully. Also, attendees have to learn and use multiple tools and platforms for the paper submission, review, presentation, and participation.

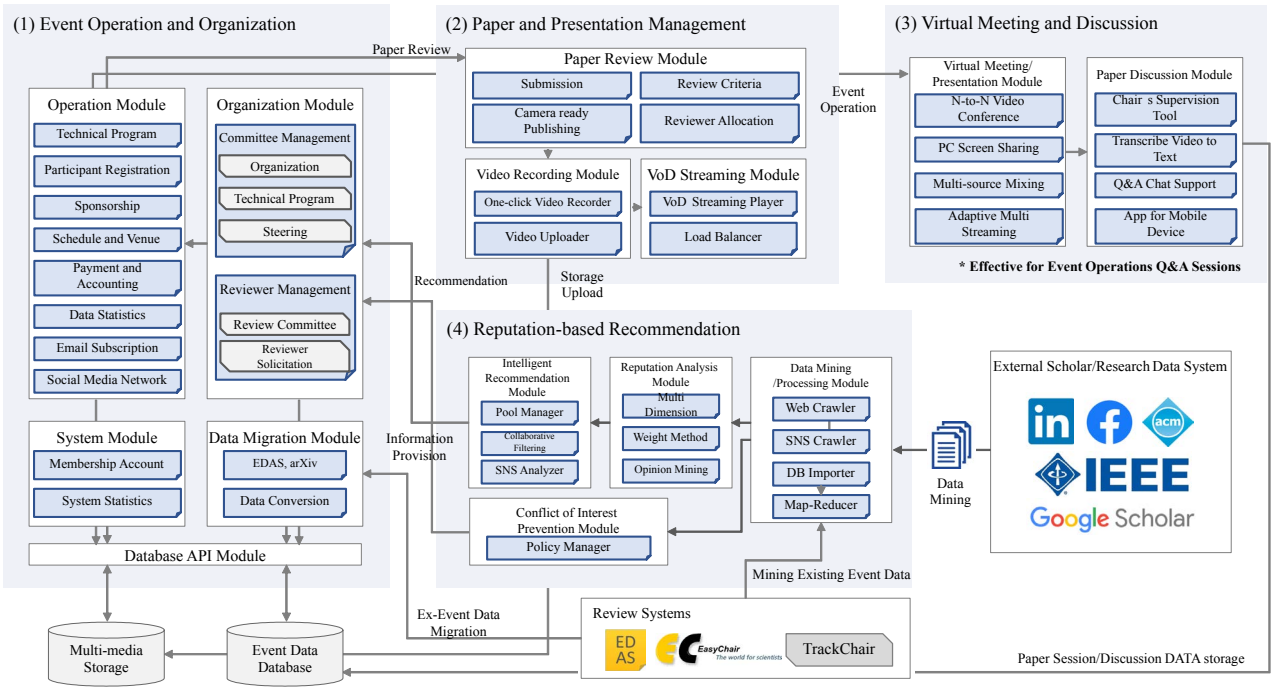


Fig. 2: System Architecture of All-in-One Platform for Virtual Conferences

III. Virtual Conference Platform Architecture

In this section, we first discuss the system requirements which all-in-one platforms for virtual conferences should meet. Then, we describe the system architecture and the underlying technologies of the virtual conference platform.

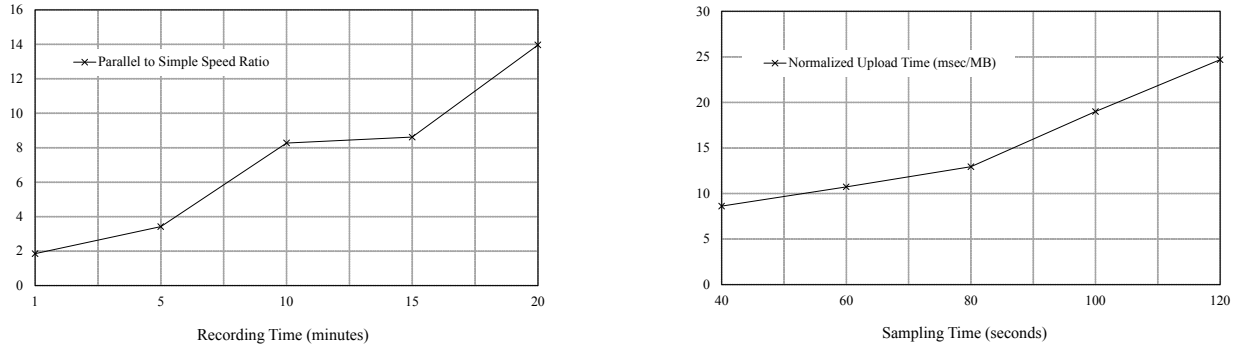
A. System Requirements

- **Extensible:** In addition to the computer and electrical engineering fields, other fields including psychology, literature, philosophy, and medicine also need virtual events. Therefore, the platform should be configurable to provide different functions and menus according to the specific size, nature, and field of the academic event.
- **Easily Usable:** Non-IT experts can host a virtual event for scholars who are unfamiliar with IT tools, Therefore, the platform should be easy enough to help scholars for online presentation, video recording, or uploading video to the cloud services.
- **Video Support:** For virtual conferences, many operations including the committee meetings, presentations, and discussions should be done through the video conference or video-on-demand streaming functionalities. The platform should support those video-related functions.
- **Recommendation:** To make conferences competitive, qualified committee members and reviewers are indispensable. The existing systems like EDAS only provide simple keyword search functions. The platform should collect and analyze data from academic databases such as Google Scholar [5] or arXiv [6]. Based on the results, the platform should recommend qualified scholars based on the topics or research interests.

B. Platform Architecture

The platform architecture for virtual conferences is depicted in Figure 2. The platform consists of four main modules and the external systems which are elaborated as follows.

- **(1) Event Operation and Organization:** This module is responsible for the overall operations of the virtual conferences. It provides the committee, reviewer, email, system management, data migration functions, etc.
- **(2) Paper and Presentation management:** In the academic conferences, the papers are submitted, reviewed, and published. For the accepted papers, authors present their papers using the recorded video clips. This module handles paper-related functions.
- **(3) Virtual Meeting and Discussion:** Since the all operations of the event are processed remotely, the video conferencing functionalities should be supported. Through this video functionalities, not only committee meetings but also paper discussions can be carried out.
- **(4) Reputation-based Recommendation:** To make a conference competitive, it is needed to recommend the right reviewers who have specialities in the subject of the reviewing paper. For this, the platform implements reputation-based recommendation engine.
- **(5) External Systems:** Since there are legacy systems which are used for the past events, the platform should support inter-working with the external systems. The considered external systems for the potential inter-working are (i) the existing review systems including EDAS, Easychair, and Trackchair, (ii) the scholar/research databases including IEEE xplore, ACM digital library, and Google scholar.



(a) (b)

Fig. 3: Parallel Upload Performance for Uploading a Video while Recording

C. Underlying Technologies

- **WebRTC:** WebRTC (Web Real-Time Communication [7]) is a standard protocol which supports various media functions without any plug-in installation. The platform utilizes the WebRTC technology for the virtual meeting with low latency and the real-time presentation recording.
- **STT:** The platform employs STT (Speech-To-Text) to automatically transcribe video speeches to text of presentation videos. With this, viewers can (i) understand the context of a video more easily, (ii) search a video that fits to a specific topic effectively, (iii) access (or jump forward/backward) to a particular point of the presentation video selectively.
- **Adaptive Streaming:** Since the device and network capabilities of attendees may differ, the platform should be ready to support diverse scenarios. To cope with the diversity, the platform adopts adaptive streaming technologies such as HLS (HTTP Live Streaming [8]) or DASH (Dynamic Adaptive Streaming over HTTP [9]).
- **Big Data Analysis:** To recommend domain experts as committee members or reviewers, it is needed to collect academic data from the various sources. We build a big data platform to analyze data such as social graph, academic activities, and reputations for the recommendation.

IV. Experimental Results

Since the presentation is done remotely in the virtual conferences, a presenter should prepare and upload his video presentation. To enhance the usability and reduce the waiting time, the platform implements the parallel upload function which generates small video chunks and uploads them while recording. We compare its performance with the simple upload scheme, which uploads the whole video file only after the recording is over. We conduct the measurement in the real environments using Amazon S3 cloud storage [10].

To show the upload performance enhancement, we measure the parallel to simple speed ratio, which is defined as the parallel upload speed over simple upload speed. As shown in Figure 3a, the parallel upload scheme outperforms the simple upload scheme (i.e., 1.8 times for 1 minute recording time and 13.9 times for 20 minutes recording time) and the performance gain is increasing as the recording time increases. It is because the parallel upload scheme can utilize the available time during recording for uploading and the amount of available time increases as the recording time increases.

The parallel upload scheme periodically generates and uploads video chunks for the efficiency. To verify the effect of sampling time, we measure the normalized upload time which is defined as the upload time (msec) divided by the video size (MB). Figure 3b shows that the normalized upload time is increasing as the sampling time increases. The smaller sampling time can utilize the computing and network resources more intelligently, resulting in higher performances (i.e., 8.6 msec/MB for 40 second sampling time). However, since the smaller sampling time incurs the larger video size, it is needed to optimize the network performances.

V. Conclusion

In this paper, we proposed an architecture of an all-in-one platform for virtual conferences. The platform architecture is designed to meet the system requirements such as extensible, easily usable, video support, and recommendation features. To help a presenter preparing and uploading his video presentation, the platform implements the parallel upload function which utilizes the available time while recording and achieves the higher upload speed. As our future work, we will apply the platform to various virtual events scheduled in 2021 and 2022 to verify the feasibility and usefulness.

Acknowledgements

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