# A Smart Campus Communication System

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*Abstract*— Notices, posters, digital panels, social media, and emails are the various means of communication within a campus today. Existence of multiple means leads to confusion and the information to be delivered can be missed or forgotten. To address this issue, we aim to create a steadfast workflow that will enable the individuals pertaining to an institution connect with one an-other, share information and participate in various events in a timely and a smart manner

*Keywords*—Smart Campus, IPFS, email, instant messaging, collaboration, document management, digital signatures

## I.  INTRODUCTION

Campus communication today takes place in various forms including circulars, notices, posters, digital panels, social media and emails. This cluttered landscape however, hinders the collaborative process of academia where important messages can be lost or forgotten.

By leveraging the fact that most individuals consume content from their personal devices, we can create a dedicated workflow to address the gaps in communication as well as organization of documents, information etc.

An application like this will instantly become a space for students, faculty as well as the administrators of an institution to communicate and learn from each other. With this, we aim to build a college community and encourage lively discussions through a smart campus communication and notice board.

## II.  RELATED WORK

There are many existing solutions for collaboration and communication. In this section, we discuss these various forms of digital communication, their benefits and drawbacks.

### A.  Email
Email is based on a store and forward technology. Hence, it is the primary mode of asynchronous communication which lends itself well for business and official purposes. An important feature of email is archival of older messages which ensures a permanent record of messages, threads and attachments.

However, there's no opportunity for synchronous, real-time conversation via e-mail. Due to the technology involved, there will always be a lag between the time a message is sent and the time that it's delivered. One might have to wait a couple of hours or even a day for a response at times. For this reason, e-mail is usually reserved for messages that fall inside a certain window of time sensitivity.

There is also the problem of spam messages in e-mail which is a source of nuisance, malware and junk. Group discussions also tends to be inconvenient compared to its Instant Messaging counterpart as explored in [1]

### B.  Instant Messaging (IM)
Instant messaging ensures a real-time communication which is very similar to telephonic or face-to-face conversations. However the communication is not organized for an academic setting. Instant messaging does not usually allow users to store, label or organize messages into categories and subjects.

Also, owing to how IM chatrooms are organized, there is only a single thread of conversation at any point of time. This limits the number of topics that can be discussed within a single chatroom.

### C.  Other Collaboration Solutions
Many collaboration softwares have emerged in the recent times which provide team oriented functionalities such as instant file sharing, organized conversations and integration with other services. Some examples of such software are Slack, Asana, Podio and Basecamp.

Such solutions are focused around project management, built for development teams to collaborate from multiple

locations. However, such solutions fall short when it comes to Campus and Academia based requirements and functionality.

## III. COMMUNICATION WORKFLOW DESIGN

### A. *Communication Theory and Campus Hierarchy*
Within a university, there are two levels of communication: vertical and horizontal.

Horizontal communication is between people holding the same hierarchical positions. Conversations between a group of students or faculty falls under horizontal communication. When communications occur between a superior and subordinates, it is called vertical communication. For example, a conversation between a student and his faculty.
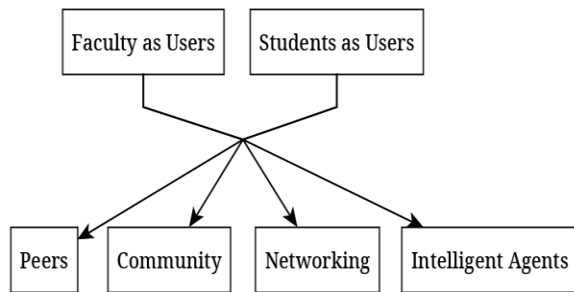

Figure 1.   Institutional Communication Hierarchy

### B. *Notice Board Workflow*
Notice boards are a unique case communication objective to a college campus.
Figure 2 describes the general workflow for a smart notice board system.
Anyone who is authorized to put up a poster on the notice board system is given a form interface which hooks up to the database backend. An automated obscenity filter scans and approves a poster before storing it in the database. A special user called a 'Notice Board Moderator' decides whether a poster is visible to the rest of the users.

Further, because the posters are digital, it can be enhanced with hyperlinks and interactivity. On the reader end, notices are filtered according to the user preferences and designations.
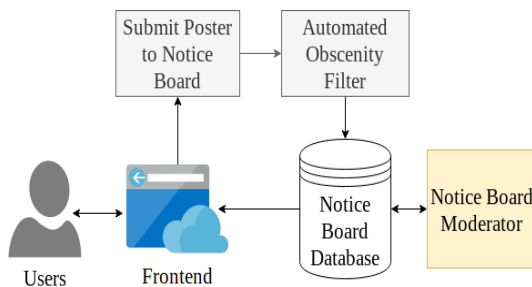

Figure 2.   Notice Board Workflow
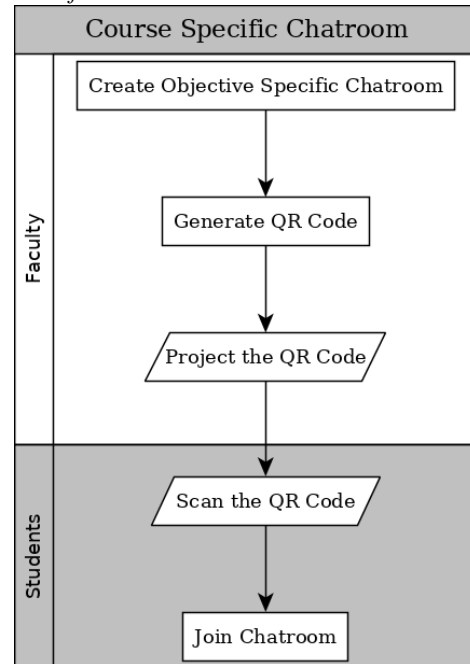
### C. *Chatroom for Coursework*


Figure 3.   Creating a chatroom for a specific Course

Another very common use case is encountered, when a faculty wants to create a chatroom specifically for discussions and study material distribution pertaining to a specific course. There are two ways to achieve this.
1.   Keep track of students, faculty and different the courses using a software backend. This approach will require tedious manual input about the same for each faculty and student and tends to be infeasible.
2.   Allow the users to create their own chatroom for specific purposes, while at the same time provide a mechanism to easily add a collection of members. This solution is more robust, and scales better.

The users are allowed to generate a QR code associated with a chatroom they are authorized to. Any other user is allowed to join that chatroom once they scan the QR code.
Using this feature, whenever a faculty wants to create a chatroom specific to a particular course, he or she can display the QR code which the students join by scanning it.

### D. *Events and Chatrooms*
Among other things, colleges are full of events in different categories (cultural and technical) with different committees of students and faculty presiding over them.
Figure 4 describes the organization of an event object. Once an event is approved by the respective authority, the smart campus communication system will automatically generate the required chatrooms and assign it to the organizers.
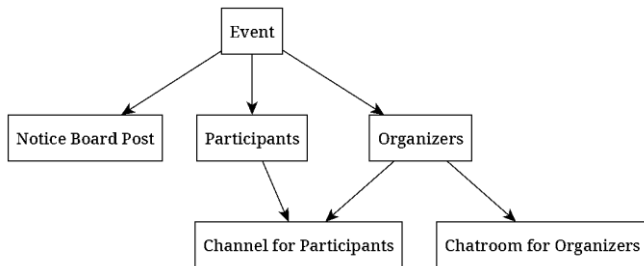
Figure 4.   Organization of an Event Object

## IV. ORGANIZATION OF A CHATROOM

As discussed in II-B, one of the main limitations of a traditional IM based chatroom system is that there can always be only one thread available for discussions. This limits the scope compared to email, for simultaneous discussions about multiple topics with the same party.

To address this issue, a chatroom is further divided into different subjects. A 'Subject' is characterized as a subset of all messages sent in a particular chatroom. Each participant in the chatroom is allowed to create a new `subject' to discuss a new topic.
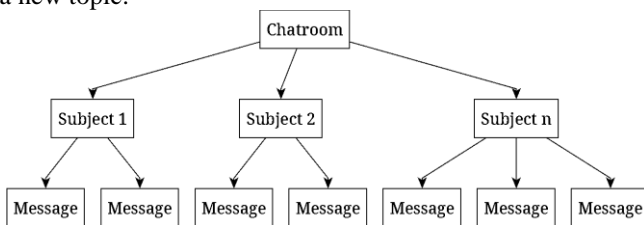


Figure 5.   Organization of a chatroom

## V. DOCUMENT MANAGEMENT AND DIGITAL SIGNATURES

Educational institutions have an enormous amount of paperwork to deal with. Admission forms, fee receipts, student records, attendance records and exam scripts fill up a lot of storage cabinets in schools and colleges. Organizing these records, and finding a particular document when needed can be a challenge. This traditional and inefficient method of paper document management is still largely practiced by most institutions.

There is a requirement for a more efficient and streamlined process to import, retrieve, index, organize, manipulate, secure and approve documents in a college campus. An electronic document management system can transform the way universities handle their documentation.

This module integrates closely with the communications module to automate many routine processes such as approval of an event by the concerned incharge, permission for leave and other office related activities.

*A.   Digital Signatures*

Digital signatures are equivalent to that of handwritten signatures and are unique to every signer. They provide an extra level of security by verifying the identity of the person signing, solving the problem of tampering and impersonation in digital communications. Digital signatures are based on public key cryptography, also known as asymmetric cryptography that makes use to two cryptographic keys: public and private.

When an authority receives documents that are to be signed, he or she can electronically sign the document. The signature is created using the private key, which is securely stored by the concerned signer.

The mathematical algorithm acts like a cipher, creating data matching the signed document, called a hash, and the private key is used to encrypt that data. The resulting encrypted data is the digital signature. The signature is also provided with the time at which the document was signed.

*B.   Document Archival using IPFS*

Inter Planetary File System (IPFS) is a peer-to-peer, distributed file system that connects all computing devices with the same system of files.

Due to the permanent nature of objects in IPFS, it is ideal for a campus setting, where records, study material and document needs to be archived for long periods of time.

File sharing is another major aspect of academic institutions. The same documents (such as study material, coursework, and lecture notes) are usually accessed by a large set of people at a time. Hence, an IPFS based system is more effective as it reduces the amount of load on a campus network as well as the bandwidth necessary.

## VI. DIGITAL IDENTITY MANAGEMENT

Multiple identification cards are used by the individuals to avail various services provided by the institution. There are separate ID cards that are in use for visual identification, building and door access, library facilities, food services, transport and parking facilities by both students and faculty. It is inconvenient to carry around multiple ID cards.

In a smart communication system, each individual associated with the institution will be provided with a digital identification card which contains a bar-code specific to the user. This barcode system facilities the communication between the different service providers and automated attendance systems.

## VII. TECHNOLOGY STACK

The communications module is implemented using WebRTC and Golang for concurrency and scalability. Database is provided using MariaDB. The backend provides a RESTful API for the front end to consume.

The front end was developed using web technologies and native android for a mobile application.

DocuSign provides the electronic signature solution and will be integrated with the backend. IPFS server for document storage is implemented in Golang.

## VIII. CONCLUSION AND FUTURE SCOPE

In this paper, we have proposed a Smart Campus Communication System that will significantly improve the conventional processes of communication practiced within academic institutions. Academics is a collaborative project to generate knowledge, and the proposed system is going to streamline this process of collaboration as well as communication within the campus.

## REFERENCES

[1] A. X. Zhang, M. S. Ackerman, and D. R. Karger, *"Mailing lists: Why are they still here, what's wrong with them, and how can we fix them?"* in Proceedings of the 33rd Annual ACM Conference on Human Factors in Computing Systems, ser. CHI '15. New York, NY, USA: ACM, **2015**, pp.**4009–4018**. [Online]. Available: http://doi.acm.org/10.1145/2702123.2702194

[2] A. Quan-Haase, *"Instant messaging on campus: Use and integration in university students' everyday communication,"* The Information Society, Vol.**24**, No.**2**, pp.**105–115**, **2008**. [Online]. Available: https://doi.org/10.1080/01972240701883955

[3] J. P. Dimond, C. Fiesler, B. DiSalvo, J. Pelc, and A. S. Bruckman, *"Qualitative data collection technologies: a comparison of instant messaging, email, and phone,"* in Proceedings of the 17th ACM international conference on Supporting group work. ACM, 2012, pp. **277–280**.

[4] A. J. Flanagin, *"IM online: Instant messaging use among college students,"* Communication Research Reports, Vol.**22**, No.**3**, pp.**175– 187**, **2005**.

[5] R. S. Weisskirch and S. S. Milburn, *"Virtual discussion: Understanding college students' electronic bulletin board use,"* The Internet and Higher Education, Vol.**6**, No.**3**, pp.**215–225**, **2003**.

[6] M. M. serbinis, d. leibu, e. v. chrapko, and v. pappes, *"Internet Document management system and methods,"* Jun. 24 2003, us patent 6,584,466.

[7] J. Benet, *"IPFS - content addressed, versioned, p2p file system,"* **2014**.

[8] J. D. Grallo, M. Chalmers, and P. G. Baker, *"How do I get a campus ID? the other role of the academic library in student retention and success,"* The Reference Librarian, Vol.**53**, No.**2**, pp. **182–193**, **2012**.

[9] M. Collins, *"The use of email and electronic bulletin boards in college-level biology,"* Journal of Computers in Mathematics and Science Teaching, Vol.**17**, No.**1**, pp.**75–94**, **1998**. [Online]. Available: https://www.learntechlib.org/p/15202

[10] S. Alam, M. Kelly, and M. L. Nelson, *"Interplanetary wayback: The permanent web archive,"* in Proceedings of the 16th ACM/IEEE-CS on Joint Conference on Digital Libraries, ser. JCDL '16. New York, NY, **USA**: ACM, **2016**, pp. **273–274.** [Online]. Available: http://doi.acm.org/10.1145/2910896.2925467

[11] M. Stranach, *"Emergent tools for teaching and learning: Mattermost, hypothes. is, and appear. in,"* **2019**.

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