

# Applying Online-based Publisher-Subscriber Network to Distribute Notice in Academic Institutions of Bangladesh

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**Abstract**— Notice delivery is an essential activity to distribute important information at different levels of academic institutions of Bangladesh. Most of the academic institutions in Bangladesh use central notice board or mail man to distribute paper based notice to different levels of stakeholders. Due to the lack of synchronization, many a time, stakeholders are not well informed about several activities and events that are planned in an institute. As a result, participation in non-academic activities does not demonstrate good development. In order to improve this issue, we propose an online based publisher-subscriber network to deliver notice to academic stakeholders of any institute. This application improves the usual model by introducing hierarchy based group wise notice dissemination as well as supports multimedia (i.e. text, pdf, image, video, audio, etc.) content delivery. We have developed the proposed system and applied it in a University setup to demonstrate the efficacy of the proposed model.

**Keywords**—Publisher, Subscriber, Hierarchy based notice delivery, Academic institutions.

## I. INTRODUCTION

Application field of computer science is ever increasing. Everyday people share their experience, opinion, ideas online as well as consume various digital services that effectively change their life. Dimensions of computing devices are also increasing as well as the access of information through internet. Users are engaged with their versatile computing and networking devices, which require asynchronous communications in a loosely-coupled and self-depended fashion that is immune from network failure [1]. In order to get appropriate attention from an individual, information has to reach the ubiquitous screen of a stakeholder at his/her own comfort. Smartphone is a very personal device that has become part and parcel of modern life, which ensures ubiquitous consumption of necessary information.

A statistic of [11] shows that the number of mobile phone users in the world is expected to reach three billion marks by 2019. At the same time people are spending a lot of time in the social networks such as Facebook, Twitter and Instagram etc. Academic stakeholders are no stranger to this practice specifically students in the ages of 18 and 24 years [12]. As a

result, a good amount of productive academic time is wasted every day. Bangladesh is also facing the same problem, as students are more involved into their social network than other non-academic activities such as sports, cultural or personality building voluntary activities. To overcome this problem, we have proposed an online based publisher subscriber network to deliver notice to academic stakeholders involved at various levels of an institute.

In addition to this issue, an academic institution can be of any size from small, medium to large. There can be various departments and different special interest groups inside or across departments or all over the institute. Sometimes there is no need to send information to everybody in a network. In a traditional notice delivery model, it is difficult to control the quality and secrecy of information flow. In this paper, we present a publisher-subscriber network to manage hierarchies inside an academic institute. We have applied the system in a University setup, where there are different faculties and each faculty manages various departments. A good number of students study in a department, where they can be grouped according to their study year such as 1<sup>st</sup> year, 2<sup>nd</sup> year, 3<sup>rd</sup> year etc. There are faculty members, who are appointed to a department and are managed the Dean of the faculty or school. Through our system, a publisher (i.e. Dean, Department Head, Registrar office) can initiate important multimedia notice to different special interest groups as well as to the general audience. Important notice can also be archived, searched, or easily managed in the proposed system. Our approach has been tested in a controlled environment and demonstrates the improvement of notice consumption by students of the testbed university department.

Rest of the paper is organized as Section II describes the literature review, Section III presents the proposed system architecture, Section IV describes implementation details of the proposed system, Section V presents the experimental results and finally Section VI conclude the paper with some important future works.

## II. LITERATURE REVIEW

In a publisher/subscriber (pub/sub) system, publisher generates content, subscriber shows interest about the content [8]. Subscribers can be organized in groups or subgroups and after publishing of any content, information will be distributed to the subscriber following some filters [1][5]. Subscribers are notified about the new contents in a pub/sub system following some notification service model [2]. To date, many pub/sub systems have been developed to provide loosely-coupled, event-driven messaging services [14, 15, 16].

There are four types of publisher-subscriber system: (i) *Topic based pub/sub*, where events are classified as topic or keyword. Messages can be grouped according to any assigned topic. Subscribers show their interest to any specific topic [6]. Each topic corresponds to a logical channel ideally connecting each possible publisher to all interested subscribers [10]. (ii) In *Content based pub/sub* system, a subscriber only receives the content he/she has subscribed [13]. The advantage of a content-based system is its flexibility. A subscriber does not have to learn a set of topic names and their content before subscribing [9]. (iii) In *Subject based pub/sub* subscription targets a group, channel or topic and the user receives all events that are associated with that group [9]. (iv) *Topic based pub/sub* can further be improved which is called *Type based pub/sub* system. Topics are represented as content type and a subscriber can subscribe to any type or hierarchy of types [6].

There are many applications that use pub/sub system as fundamental architecture of their message communication. *Microsoft Developer Network Publisher/Subscriber* system uses topic and content based pub/sub model [2]. For example, applications that manage customer information are interested in information updates about customers. Trading applications are interested in buy and sell transactions. Applications that participate in two-phase commit transactions are interested in commit messages.

IBM MQ-Distributed Publish/Subscribe Network follows topic-based pub/sub system, where each queue manager matches messages published to a topic with the locally created subscriptions that have subscribed to that topic [1]. You can configure a network of queue managers so that messages published by an application connected to one queue manager are delivered to matching subscriptions created on other queue managers in the network. Google cloud offers scalable, low latency pub/sub system that can easily integrate external systems with google services [4].

Our proposed system fits as a type-based pub/system since it can distribute academic institution related notices in hierarchically organized interest groups. A publisher can initiate a content for a certain group and selection mode of transmission. A mode determines which path a content will be routed. For example, public mode means a content will be distributed to all the groups and subgroups subscribers,

whereas selective mode offers the option to distribute notices to a specific group of people. Our implementation and experiments show that our approach can significantly improve the quality of notice consumption in academic institutions.

## III. PROPOSED SYSTEM ARCHITECTURE

In this section, we describe the proposed pub/sub based notice delivery model. The architecture can be defined as network structure model and data dissemination model. Following sections describe the systems in detail.

### A. Network Structure Model

In our proposed online based notice delivery model, an organization is structured in hierarchical order of various level of publishers (Fig. 1). For example, in an University there can different types of publishers such as Dean Office, Committees, Administration Office. Again, Dean Office can have some other publishers such as various departments (i.e. CSE, ECE, MATH, STAT etc.). Further a department can manage students of different years (i.e. 1<sup>st</sup> year, 2<sup>nd</sup> year, 3<sup>rd</sup> year, etc.). On the other hand, Administration Office further can have publishers such as Office of Controller Examination (OCE), which further can be divided as result verifier, exam controller. The network structure of the proposed model imitates the organization structure, in this case an University.

Subscribers can subscribe contents that will be generated by different levels of publishers. One subscriber can subscribe to any number and at any level of publishers. Publisher can decide the type of content should be distributed. In this case the types are public, private and selective.

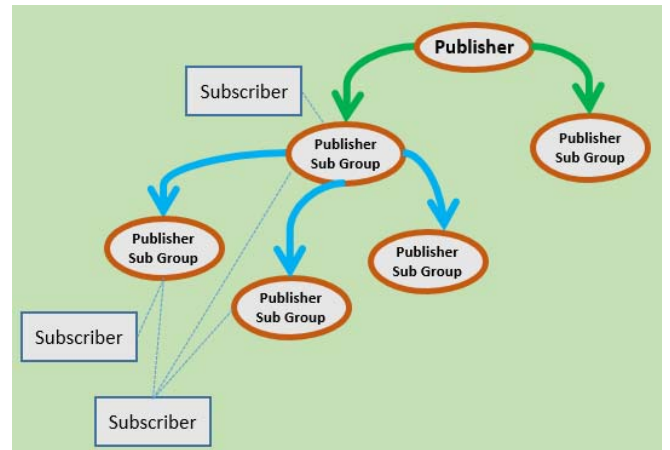


Fig 1. Network structure of the Pub/Sub based Notice delivery model

### B. Data Dissemination Model

In this section, we describe about the data dissemination model of our proposed notice delivery system.

a) *Public Mode*: When the publisher publishes their publication under a group without selecting any mode then the data or notice will be distributed to the members/subscribers of his/her own group and all the

members of its sub-groups. For Fig. 2, if the university authority publishes some notice in public mode, then all the subscribers CSE, ECE, CSE13, CSE14, ECE13, ECE14 will receive that content.

b) *Private Mode*: If the publisher wants to publish some publication under a group/sub-group in *Private* mode then the data will be distributed only to the members/subscribers of that specific group. Even data will not be transmitted to the child subgroups of a particular group (Fig. 3). A publisher can also control the private mode by selecting how many levels the transmission should travel. By default, the level is (=1) but the publisher can control it.

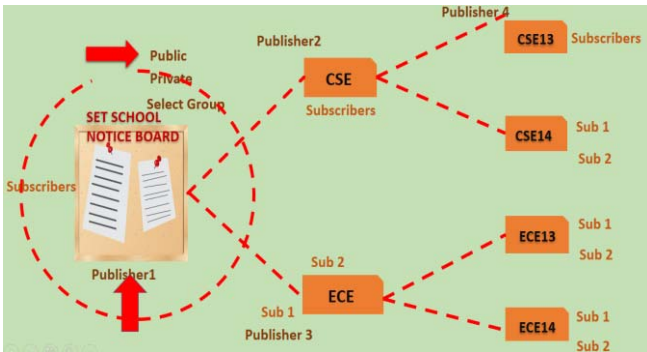


Fig. 2: Public mode data dissemination

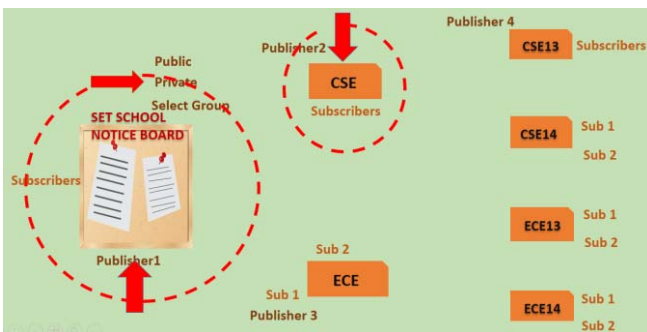


Fig. 3: Private mode data dissemination

c) *Selective Mode*: If the publisher wants to publish some publication to a list of groups then he/she can select this mode. A publisher can also combine the features of private and selective mode while sending contents to different groups (Fig. 4).

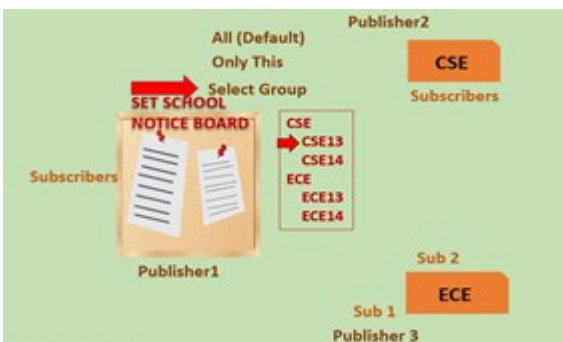


Fig. 4: Selective mode based data flow

#### IV. PROTOTYPE SYSTEM IMPLEMENTATION

Here we discuss our system implementation approach. We have built the online application using PHP as backend, HTML as client side and MySQL as the database. The application follows a 3-Tier architecture. User interface design of the system is responsive and can fit to any type of computer screen (i.e. desktop, mobile, tablet, etc.). The System has five parts, the Main Admin Panel, the General User Panel, the Organizer/Organizer Admin Panel, the Publisher Panel, and the Subscriber Panel. From main admin panel, the admin will manage whole the system, general user will view all institute/organization and can send a request to become a subscriber or a publisher. The publisher can publish notice from his/her publishing group, the subscriber can subscribe to any group that the admin approves and get all notice under his/her subscribed group. Fig. 5 shows the architecture of the implemented prototype application.

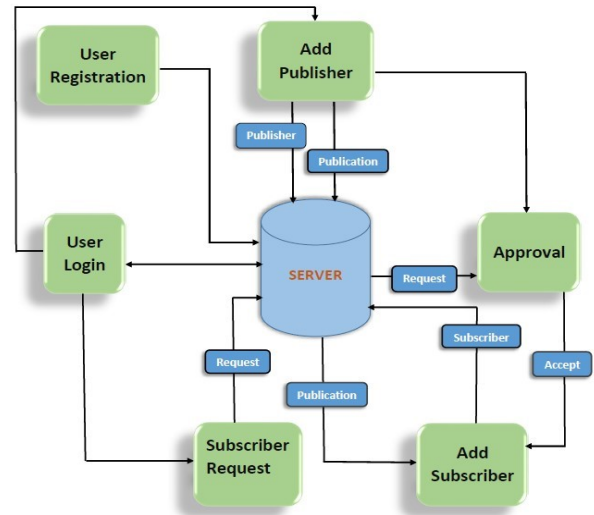


Fig. 5: Architecture of implemented Pub/Sub network.

##### A. Publisher/Subscriber Request

After creating an account, a user gets a home page, from where he can search or select any institute or organization that are part of the hosted system. After selecting the organization, the users get another page for sending the request. Here any user can send a request to the organizer to be a publisher of any group and send a request to the publisher to be a subscriber by selecting the group name from the drop-down menu (Fig. 6). An organizer can accept or reject the request of the publisher from the user (Fig. 7). A publisher can see all subscribers request for all his/her publishing group and accept or reject the request of the subscriber (Fig. 8).



Fig. 6. Send publisher/subscriber Request

### B. Create Notice/Post

When any user becomes a publisher then they get another page for his own. That page is not accessible for every user. The publisher can see all his/her publishing group. The publisher can post text, image and any kind of file for their necessity from their own publishing group. They can post their notice in different data transmission mode (Fig.19).

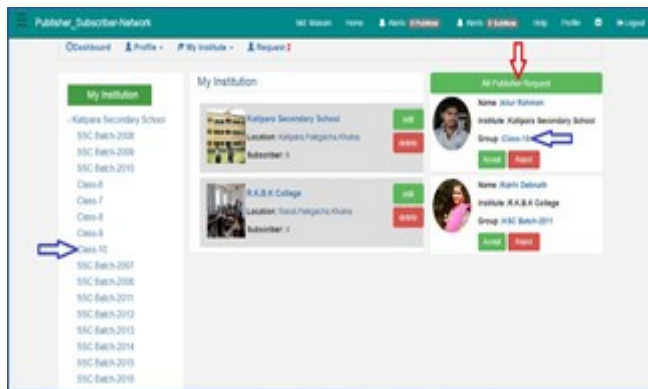


Fig. 7. Accept Publisher Request

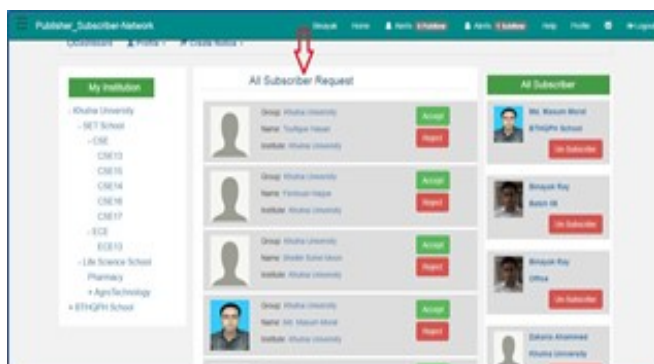


Fig. 8. Accept Subscriber Request

### C. Subscriber Page

When any user becomes a subscriber then they get another page for his/her own. That page is not accessible for every user. Subscriber will get an important notice from his/her subscribed group or upper level of that group. Here the subscriber can store an important notice in his favorite list. They can also remove their favorite list if they want. They can search notice with the subject and any range of date

(Fig.10). As a result, all the notices are kept organized and easily accessible whenever required.

## V. RESULTS AND DISCUSSIONS

We have deployed our developed system in a University setup, where there are various administrative, and academic departments are present. Academic departments belong to a Dean office and each academic department manages a pool of students. Students can be grouped according to their current academic year. The system has been used by Computer Science and Engineering department of Khulna University to distribute University and department related notices. Also, students used the system to distribute internal notices among their groups, which demonstrates the use of hierarchy of the proposed system.

After a prolonged use of the deployed system in the web, we ask the students both male and female participants to fill a subjective questionnaire. We have prepared 21 questions for our experiment. We publish the questionnaire in the social media and request the participants of the experiment to fill it. Our subjective analysis has two parts. In first part, we ask the participants about some usability questions regarding the system. The second part of the experiment gathers comparative user response about traditional notice delivery and proposed pub/sub based notice delivery.

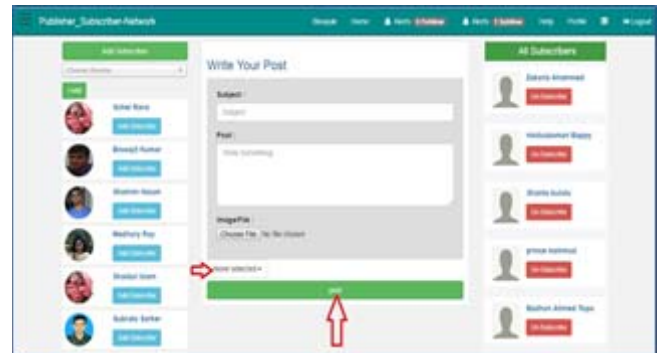


Fig. 9. Create Notice/Post

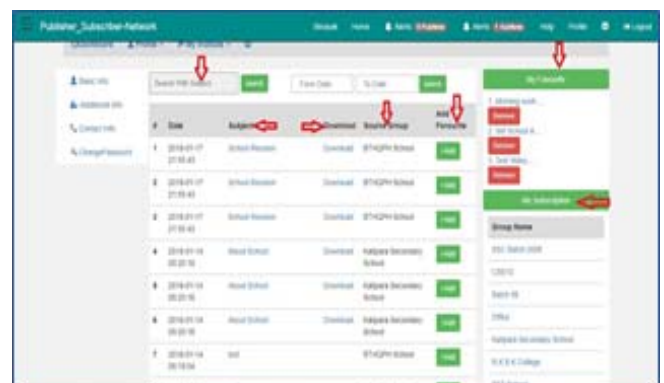


Fig. 10. Subscriber Page

### A. Usability Related Questionnaire

We devised the following questions and asked the participants to respond to our questions in the scale of 1 - Strongly Disagree (SD), 2 - Disagree (D), 3 - Undecided (U), 4 - Agree (A), and 5 - Strongly Agree (SA). We have the following 15 questions related to our usability survey.

#### 1) Organizer Management

- Easy to create institution and manage group and sub-group.
- Easy to manage all publishers role.

#### 2) Publisher Management

- Easy to manage all subscribers of your publishing group
- Flexible for sending any type of notice in different mode from your group
- Easy to update an existing notice

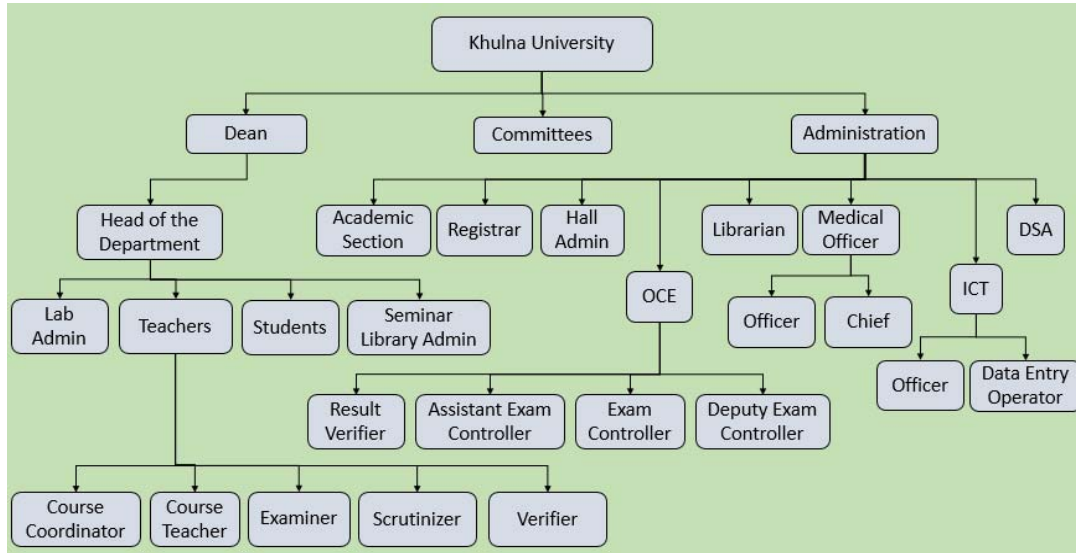


Fig. 11. Experimental setup of the proposed model in a University setup

#### 3) Subscriber Management

- Easy to show all notice at a glance
- Can show all the notice of a single group
- Searching a desired notice from the list
- Easy to download any type of file (pdf, ppt, doc, video, audio, zip, etc.)
- Easy to organize important notice as Add to Favorite.

#### 4) Device Agnostic

- Usable in laptop or desktop computer
- Usable in tablet or smartphone

#### 5) User-Friendly

- Flexible to use
- Design structure is understandable and standard
- All information is secured

For this experimental setup, 73 students participate in the survey. We collect their responses and average them for each category and put into a Likert chart (Fig. 12). The result shows that the users of the system agree on usability of the features of the proposed online based pub/sub notice delivery model. Publisher and subscriber management received a lot of interest from the users of the system. Participants described it as they regularly forget and miss important notices that is related to academic or non-academic activities, online system with device agnostic interface they can easily look for existing notices anytime.

### B. Comparative User Survey

We prepared 6 questions to differentiate the usefulness of traditional notice delivery and pub/sub based notice delivery model. This questionnaire consists of the following questions.

- Hierarchy management is an important and useful feature.
- Support publisher and subscriber management as well as support multimedia type notice (pdf, ppt, doc, video, audio, rar, zip).
- Important notices can be organized and easily found.
- Different type access modes such as public, private and selection is very handy.
- Notices can be easily organized and searched.
- Message route can be managed from higher levels to lower levels.

The same group of 73 participants take also take part in this survey. Participating students grade two systems, traditional paper based notice delivery model and the proposed online pub/sub network based notice delivery model. We collect their response regarding the above designed six questions and average their response in a Likert scale (Fig. 13). From the figure, we see that in every case our proposed system outperforms the traditional model. From the above designed experiments, we can conclude that online pub/sub network based notice delivery improves notice consumption culture in the setup of academic institutions.

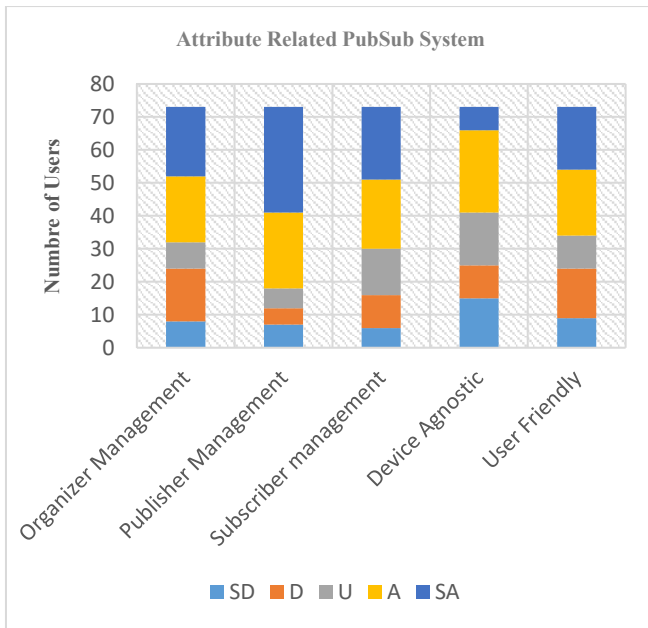


Fig. 12. Survey result of usability related questionnaire about the features of the proposed online pub/sub based notice delivery model.

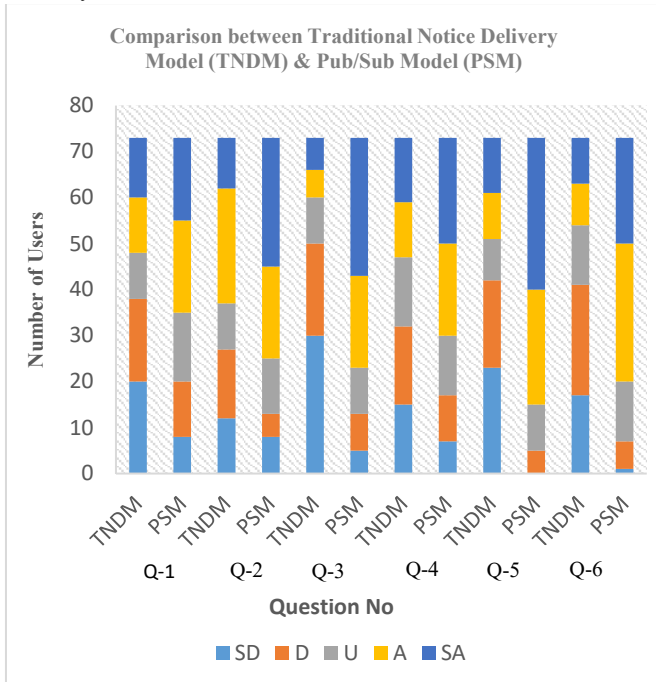


Fig. 13. Comparative study of traditional notice delivery and pub/sub network based notice delivery.

## VI. CONCLUSION

In this paper, we present an online publisher/subscriber network model to disseminate notices in the setup of academic institutions. Our proposed model improves the traditional paper based notice delivery culture and introduces new features like notice organization and searching, hierarchical notice delivery structure, mode based privacy management of the notice delivery route, multimedia notice

content, device agnostic ubiquitous notice consumption, etc. We have deployed our system in a University setup and developed some subjective experiments to demonstrate the efficacy of the proposed system. The proposed system can also be incorporated in other type academic institutions such as school, college and can be extended to every kind of notice delivery situations. We hope that the proposed system will improve the notice consumption culture of Bangladeshi academic institutions and will ensure more engaged academic and non-academic participations from academic stakeholders.

## ACKNOWLEDGMENT

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