NOTIFLY: A Facebook and Messenger Instant Notification Collaboration Tool for Organizing Information Engagement

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Abstract - **The main struggle of online workplace is the asynchronous decision making and delays in information dissemination. Productivity application and workplace media platforms are often ignored by normal users and employees. This study has developed a Facebook and Messenger collaboration tool which aimed to deliver persistent notification system for student organizations in the University of the Philippines - Los Baños. The system allows user to automate tasks such as sending individual messages and group chats for messenger chat head feature, tagging and commenting in posts on Facebook and emailing for phone notification overlay display, liking and sharing of page and posts, postings in Facebook group, and meeting notification across Facebook group, Messenger, and email. Ten respondents, five from non-academic and five from academic organizations ranging from age 20 to 23, were asked to test and evaluate the system. The application had an average score of 83.5%, which is translated to excellent and acceptable usability.**

Abstract - **persistent notification system, Messenger, Facebook, automation, web drivers, Selenium, web development, online workplace, productivity application, instant messaging**

I. INTRODUCTION

A. Background of the Study

Remote jobs and online learning continue to increase in 2022 by 15% due to virtual opportunities brought by the pandemic [1]. The increasing adoption of organizations in the industry, business, and education to online setup is utilizing social media platforms even more. Given that digitization of the workplace is prominent in 2019 [2], the year 2020 to 2022 give platforms such as Zoom, Google Meet, Facebook, Messenger, Slack, and Discord more engagements as these applications were accepted as an alternative workplace to collaborate. Discord gains 18% increase for downloads in 2020 [3]. Zoom call minutes increased by 330% in October 2020 compared to the same month last year [4]. Facebook, although saturated already, still garnered an 11% growth from 2019 to 2020, the highest growth rate it has ever recorded [5]. According to the Owl Labs 2021 State of Remote Work

Report, 90% from the 2050 remote employees states that they were more or equally productive working remotely compared to working in a physical office [6].

Even as several businesses and organizations such as schools slowly transition to face-to-face activities, the industry significantly recognizes that some transactions are more efficient if done online [6]. This includes distribution of learning materials for university students, assignment and quizzes for remote learners, announcement of news and updates, business financial report and statement, local or international community events, and most importantly, instant dissemination of information for all user accounts under a specific platform. The key advantage of this setup is that it relatively reaches a larger scope, taking into account the remote locations where physical setup is hard to implement. A study found out that productivity increases by more than 40% on virtual teams compared to physical offices. This is also strengthened by the 24/7 availability of operation [7].

Instant notification is another key factor to the success of organizations who adopt virtual setup. Notification badges and overhead displays on screen provide a user-friendly approach to deliver information quickly [8]. Moreover, some platforms like Google Mail, Discord, and Slack integrate the activities across different devices including smartphones, tablets, and desktop. Some applications collaborate with each other to provide cross-platform features and syncing of information. All of these features ensure that notifications are efficiently delivered and accessible in all possible platforms.

Virtual setup also caters to the need of instant messaging. The chat head feature of Facebook Messenger is a valuable example of this. The startup time and performance of Messenger is always being examined to offer fast messaging [9], making it an instant messaging app used in the workplace [10]. As of today, Facebook Messenger is the number one instant messaging application used in the Philippines [11].

Another concept to take into account is how online setup maximizes chat bot utilities. Many delivery applications used the system for customer support and even for placement of orders and reservation . Chat bots provide 24/7 availability with consistent response time and replies on which an organization can personalize according to their need. Chat bots could be used as an important virtual assistant that may help in ensuring full engagement across customers, students or even administrators [12].

B. Significance of the Study

Online setup is accessible and efficient. However, this does not mean that engagement and response from the users are ensured. A study found out that 60.8% of its respondents ignore emails at work. The study further recommended the use of text messaging or chatting systems as the solution [13]. Since the boundaries of workload and personal life are challenged, some people tend to ignore these messages and notifications during their leisure time. In some cases, these were unintentionally forgotten due to the overwhelming amount of activities present on someone's screen.

The disadvantage that the virtual setup has to deal with is the response rate and reply from its members. Though the messages were delivered, it is hard to verify whether those data were read accordingly. Information backlogs are crucial towards organizations who have to deal with real-time deadlines and projects. Asynchronous decisions done on polls and voting systems for example, require longer time to be finalized. Synchronous face-to-face meetings do not have to deal with these disadvantages, which makes the organization hesitant to continue virtual setups.

Notifications sent through emails and other social media platforms are shown on screen overlays and overhead displays in an attempt to solve the aforementioned problems above and increase engagement. However, loading time of these applications are relatively slower and more robust applications have to deal with speed trade-off. This makes users more hesitant to continue opening the app as they would opt to re-open it only when connectivity is more stable. These notifications are prone to be unintentionally unattended by the users.

The usage of chat bots is an attempt to resolve these issues of virtual setup. With automated messaging, the dissemination of information is uniform and easier to track. Bot systems can transmit details with one tap system in order to be sent across all member accounts with different devices and locations.

C. Statement of the Problem

Limited mobility of asynchronous decisions and decreased feedback from online information makes notifications inefficient to responses. Other notification systems such as overhead display and screen overlays do exist, but the loading time and accessibility of these notifications are dependent on Internet connectivity. Ignored messages and delayed responses proliferates information backlogs resulting to decreased workplace productivity.

D. Objectives of the Study

The study aimed to develop a persistent notification system for information dissemination. It also specifically aimed to:
1) Implement an auto-tag feature updates and notify the members of the organization;
2) Develop a chat system for messaging the members of the organization;
3) Automate share, like, and follow functionalities for pages and posts
4) Measure the usability of the system for student organizations in UPLB using System Usability Survey (SUS).

E. Scope and Limitations

This study focuses on students from UPLB-based organizations. The bot system will implement auto-tag and auto-message features of the web application. The study will measure the usability of the software as a medium of persistent notification system in an organizational setting.

II. REVIEW OF RELATED LITERATURE

A. Instant Messaging in Workplace

Instant messaging, otherwise known as IMs, are communication tools which support concurrent text-based messages. IMs receive more instant replies and deliver information faster than email and other communication channels. In an interview study conducted by Dennis and others, they have found out that IMs are used on both face-to-face and online communication. The platform is utilized on main and sub-topic interactions (which is not normally allowed on physical conversations), participation in concurrent and multiple conversations all at once, and influencing the activities and decision-making process of an organization. In this study, a pharmaceutical company used Lotus SameTime messaging application to conduct meetings and disseminate information for 18 months. The employees exchange notes from one another using Lotus Note. The technique of the study is to find out how employers use IM in the workplace. At the end of the study, they were able to find out that IMs are used in face-to-face settings as well [14].

In a study conducted by Nam Mak and others (2012) about effective workplace communication, they have found out that IM is one of the channels that helps model situated-learning platforms. This pervasive tool is often used by young adults who enter a new company to connect and observe the working environment they are about to enter. In this study, the researchers observed the behaviors of newly hired employees and how they utilized the official IM channel of the company. The study concludes that IM is an effective tool for newly hired employees to fully adapt to the new working environment. They use the system in delegating managerial concerns, logistics, and delegation of tasks [15].

The advantage of IM includes detection of presence, which is less interfering than phone calls but more immediate than email. It essentially checks the status of workers' availability and resolves issues or backlogs quickly. Feedback and information dissemination are catered by IMs on a fair scale compared to email and other communication tools. A comparative literature study conducted by Murang'a University College found out that organizations who adopt the usage of IM will gain a significant Return on Investment (ROI). Particularly in holding IM meetings, an organization can benefit from long distance travels and expenses savings in cost. The study also concluded that IMs are more coherent in topic, and thus meetings are faster in execution. The study investigated previous IM-based studies and determined whether the organizations used ICT standards or not. The authors noted that studies which incorporated IMs with proper ICT protocol produced more sound conclusions based on its performance. Business

industries who provide ICT workplace communication infrastructure indicated more productivity [16],

One of the more interesting advantages of IM is its capability to store information. A study conducted by Aflatoony and others (2022) found out that employees often read back messages to retrieve information based on previous meetings. The study focused on the reappropriation of instant messaging, where it highlights other functions of IMs aside from concurrent communication features. The researchers interview the selected participants about Personal Information Management relative to instant messaging. Open-coding and affinity diagramming is used to reveal three main ideas. (1) saving of important information, (2) retrieval of data based on previous conversation, and (3) deletion of data from the conversation. At the end of the study, they concluded that accessibility is one of the main reasons why IM is useful in a workplace [17].

The study entitled "Synchronous Text Messaging: A Field Trial of Curtains Messenger" conducted in 2017 revealed that synchronous instant messaging poses more quality conversation. The study involved using the Curtain Messenger App, where users can start communicating once both of the users are online. Though its disadvantage is the waiting time for the availability of both speakers to talk to one another, the study revealed a communication model which is more intimate and effective. The conversations are faster since important information is discussed as short as possible making the decision-making process efficient [18].

B. Push notification system

The pop up overlay features of smartphones for push notification systems has undergone minor changes for several years. There were banner head displays, screen saver displays, and emergency alert notification systems (involves vibration and sounds). These developments were attempts to encourage more responses and feedback from the user. In a comparative study conducted by Wohllebe (2020), the author stated that the increased frequency of push notification increases app usage. However, frequent interruptions also discourage the user from reading the messages repeatedly, especially if the app becomes particularly pervasive. The researcher collected relevant studies and was able to conclude that marketing managers should balance value-added information and user disruption. However, the study failed to determine the correct frequency of sending push notifications, as it cannot be measured quantitatively at present [19].

In the field of education, push notifications are used in monitoring attendance especially in online schools. Workplaces which have remote jobs could employ the same technique as well. The study entitled "Establish a Digital Real-time Learning System With Push Notification" by Wu (2022) establishes a software where students need to persistently click the button to check their present attendance while listening to the class. The system uses a "roll call" method which is monitored every given time. Since the assurance of attendance is not ensured in virtual setups, the workplace can employ the same technique in order to secure involvement of each employee in the meeting . At the end of the study, the teachers gave positive feedback on the software due to the increased attendance rate of the students over the experimental setup [20].

A study entitled "Understanding Notification Stress of Smartphone Messenger App" by Lee and others (2014) recommended three frameworks on delegating notifications to the end users. First, the contents of the pop up alerts and messages must be categorized according to contents. If each message is delivered equally, there is a high chance that emphasis is lost. Second, there must be editable update period settings. Important notifications are to be updated real-time, while secondary notifications are updated once every given hour. Lastly, the method of notification must be specified and modeled. Information can pop through the screen and alert users through vibration, ringtone, sound, LED light, and turn on display. These are important outlines which can be considered while developing a notification system [21].

C. Chat bots in workplace

There are limited studies regarding chatbots used in the workplace. Typically, the system is used for business purposes and customer service, specially in food delivery apps and online shopping websites. Chatbots integrated for the office are a great tool for increased productivity and efficiency in information dissemination, especially for online jobs and work-from-home setup. Chatbots are also used in a wide array of disciplines like health for example. The study is entitled "Towards a Chatbot for Digital Counseling" using a chatbot for mental health counseling. In this system, mental health information is delegated to the chatbot interface. The task is to develop an algorithm that can answer queries regarding depression, panic attacks, and anxiety. The researchers concluded that chatbots are relatively safe communicators. Specific users prefer this system since it offers medical advice without exposing their identities, through which they are scared of revealing to the public due to cultural pressure [22].

The self-service domain is a feature of an application which may capture data and process it on its own. This highlights the capability of chatbots to reduce workloads and cost due to automation of instructions. In a workplace scenario, workloads and cost are the main principles on which a chatbot operates. The study of Hoberts and others (2020) measured the research gaps regarding chatbots by a grounded theory process. At the end of the study, they were able to outline three core usage of chatbots. First, information capture. Chatbot systems can ask for user information through forms and data can be fetched and used by a user for any purpose. Second, process guidance and execution of tasks. Chatbots can send uniform task instructions on how to do a certain task to multiple users all at the same time. Lastly,information provision. Any announcements from the office can easily be delegated through text messages and chats, obtaining instant reaction from the receiver [23].

The same study mentioned above outlines seven disciplines that scopes the benefit of the chatbot system; internal/external support, human resources, maintenance, purchase and sales, education and training, knowledge and information management, and self-service [23].

D. Relation to the study

This study will develop a notification and alert messaging system which is anchored to the three frameworks of the research entitled "Understanding Notification Stress of Smartphone Messenger App." The three frameworks are; content categorization, update period system, and method of notification. The design and interface will take into account the division of notifications based on its urgency and importance. Updates of chatbots regarding announcements are to be implemented via interval system in order to emphasize relevant announcements. As per method of notification, the organization may follow a model of instruction that all the employers may adopt. Different methods include sounds, vibrations, and on-screen overlay display.

The study will also take into account the research entitled "Chatbots at Digital Workplaces – A Grounded-Theory Approach for Surveying Application Areas and Objectives" in terms of measuring the performance of the application. It will consider four out of the seven disciplines namely; internal/external support, human resources, information management, and self-service.

The mentioned study above will be used as a reference in developing the models and design of the system, particularly in designing its modules and features.

III. MATERIALS AND METHODS

Task automation done in social media platforms is mainly focused on monitoring the right speed to avoid spamming as well as accurate hooking of browser application elements. The database used for the system must be accessible through the cloud, and the server must be robust in order to deploy more successful queries. It is recommended to decrease load time, which can be achieved by minimizing the libraries used . This application will use API tools readily available for automated browsing activities and a low maintenance database for faster CRUD operations.

A. System and Hardware Specifications

The web application was developed using NodeJS v16.16.0 running on a Windows 11 Operating System. The specifications for the hardware used in the development are as follows:

- Unit: HP Laptop 14s Series
- CPU: AMD Ryzen 5 3500U with Radeon Vega Mobile Gfx 2.10 GHz
- RAM: 8.00 GB (5.92 GB usable)
- 64-bit operating system, x64-based processor

B. Development Tools

1) MongoDB: MongoDB is a document-oriented database system that falls under the category of non-relational databases. It facilitates JSON-like storage, and its data model is highly adaptable, allowing for the storage of unstructured data. Additionally, it offers full indexing support, and replication functionality, which can be accessed through intuitive and feature-rich APIs [24].

2) Facebook SDK for Javascript: contains a set of client-side functionalities including social plugins and Graph API calls. Graph API calls are the main ways for applications or extensions to communicate with Facebook social graph [25] . All of Facebook SDKs interact with the Graph API including the SDK for Javascript

3) Socket.IO: Socket.IO is a software library that facilitates real-time and bidirectional communication between a client and a server with minimal delay. It is constructed on the foundation of the WebSocket protocol and confers supplementary assurances such as the ability to revert to HTTP long-polling or automatic re-connection [26].

4) Selenium Web Driver: refers to the language binding and the actual implementation of individual browser controlling code. It allows native browsing like what users do. The browsing activities may be implemented on a machine using the Selenium server [27]. The Selenium WebDriver allows automation of browsing activities, particularly Facebook queries. Instant messaging to multiple accounts is possible through repeated function calls on the script. Auto-tagging and comments for Facebook posts and group status are automated using bot accounts integrated under the organization's database.

5) Nodemailer: NodeMailer is a module designed for Node JS that offers a straightforward approach to dispatching emails from your server. This module is devoid of external dependencies and can be utilized with all Node JS-compatible applications. It accommodates various email formats, including plain text, attachments, and HTML [28].

6) Google Chrome v108 and above: the primary web browser where the application is integrated

C. Application Features

Fig. 1.   Data Model Diagram

1) Members: Include the Facebook accounts of organization members inside the database using user ID. Fields for members include username, full name, and nickname. Member types can be specified according to the hierarchical structure of the organization.

2) Clusters: A Cluster is a group containing several member accounts. Classify accounts of members according to their group assignments (committee, division, or department) for categorized information dissemination. Field for cluster include cluster name.

3) Messaging: Send a message including texts and links to all or selected clusters. Personalize message contents using anchor tags of members. Successful queries are prompted immediately. Any errors caused by poor internet connection, invalid/inactivated accounts, and wrong coordinates will interrupt the query and warn the user.

4) Group chats: Send a message to multiple group chats in one click.

5) Tags: Instantly notify members by tagging their names in the comment section. Tagging can be done via cluster or everyone.

6) Pages and Posts: Media partnership requires organization to link a series of pages or posts for more engagement. The bot system can use the present account to like and share number of posts, and like or follow series of pages..

7) Meetings: Alert members about meeting credentials and schedules persistently via mail, direct message, or group chats.

8) Groups: Post same status across different Facebook group in one click

D. System Implementation
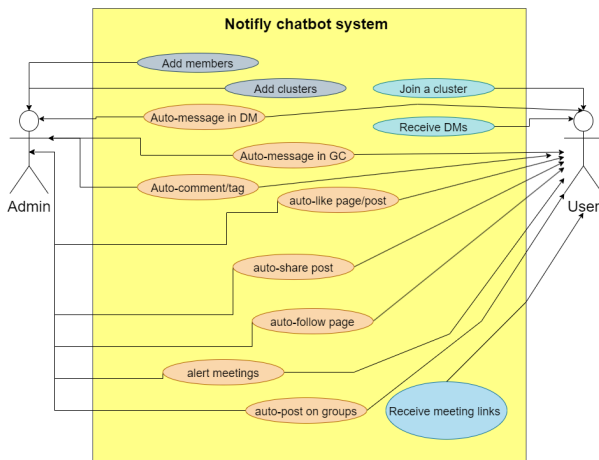
Fig. 2.   User Diagram

The developer manually coded all the features which are mentioned in the Application Feature. These individual features are incorporated in separate modules. The developer designed appropriate database model using MongoDB, which is deployed in MongoDB Atlas. The application is built using NodeJS, with important libraries such as Mongoose, Express, and Socket.IO in the backend. Importantly, the system used Selenium functionalities to automate the browser tasks.

For user experience, there are pre-value inputs in form fields for reference. Form validation is implemented in order to launch valid commands. Success and error alerts are displayed on pop-up screens for each queries. The system uses ReactJS components with Bootstrap for frontend.

There is little UI in order to load the application faster. While designing the application, the developers take into account the study [21] on notification stress. (1) content categorization will be catered by order of urgency. Most important notifications will have to be directly messaged in individual accounts. Less important notifications can be done through comments and tagging. (2) update period system is incorporated by the organization itself. The admin will decide the intervals of announcement based on their own organizational structure. The frequency of notification is inversely proportional to response, so this consideration is important [21]. (3) method of notification is implemented entirely on Facebook notification integration, specifically; chat head system, notification bell, overlay banners, home screen alerts, and sound or vibration integration.

The developer used the local machine in order to run the website for testing. Each data are updated in MongoDB Atlas. Every queries and task automation were implemented nonheadless, which means that a browser will be explicitly opened to see the results of the automation.

E. Research Environment

The software was tested inside the University of the Philippines - Los Baños, Laguna. The selected participants are second to fourth year college students enrolled in the university. The participants were categorized into two groups based on the nature of their organizations: academic and non-academic.

F. Testing Method

To evaluate the performance, usability, and accuracy of the system, the participants were instructed to operate as admins for their respective organizations. They were given task prompts that contain specific goals to complete within the system. The website was deployed on a local machine, allowing the user to browse the web application independently.

All the queries done in the system were recorded and saved in the database, and participants received real-time notifications through Facebook, Messenger, and Gmail. Participants provided their authentic account information to receive data from the system. Testers were also required to create their own Facebook groups, group chats, post and page partnership lists, clusters, and members to simulate the web application's modules.

IV. RESULTS AND DISCUSSION

A. Web Application

1) Login: Users can login their accounts and access the functionalities by logging in the valid admin Facebook credentials. Only valid Facebook credentials are accepted. Once verified, the dashboard will be opened to the user.
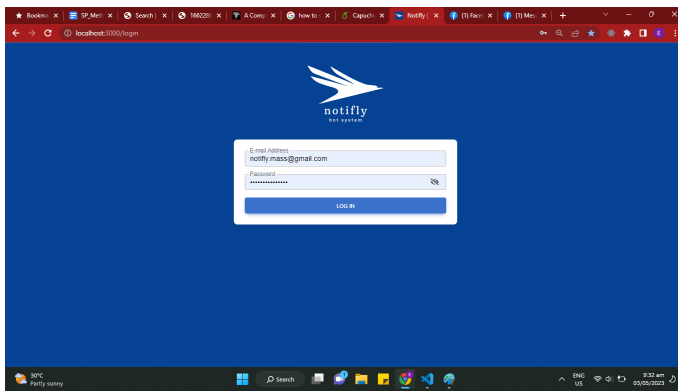
Fig. 3. Login Page

Fig. 6. Create Member

2) Clusters: Users may add a cluster by specifying a unique cluster name. Members inside the cluster can be displayed and the cluster name itself can be edited.
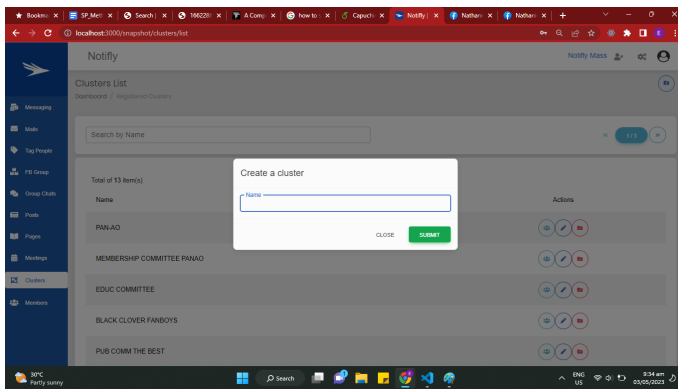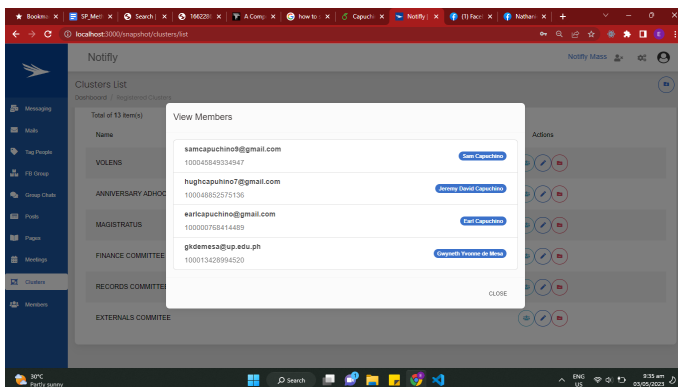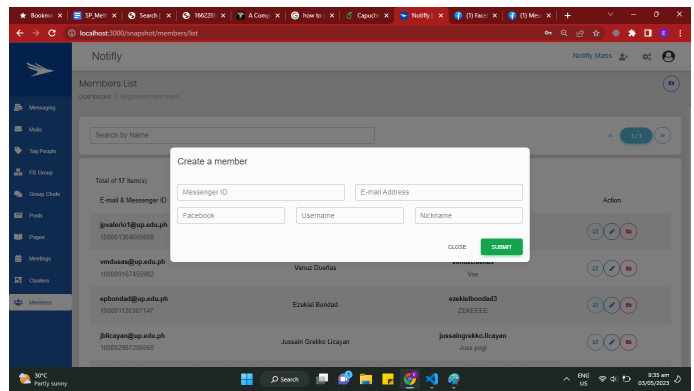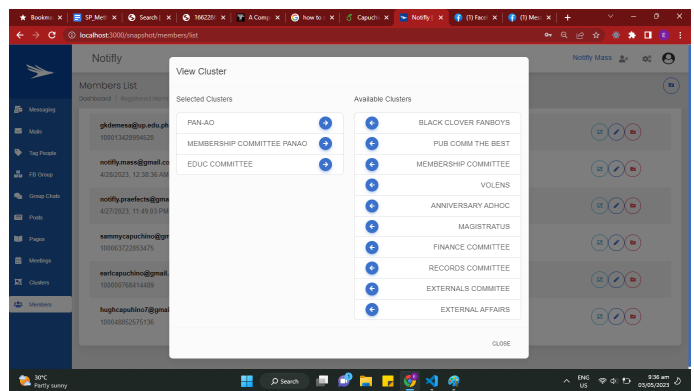

Fig. 4. Create Cluster:

Fig. 7. View Member

4) Messaging: Users can message one or more clusters in Messenger. The recipients are selected through a checklist and the generated message is inputted inside a text box.
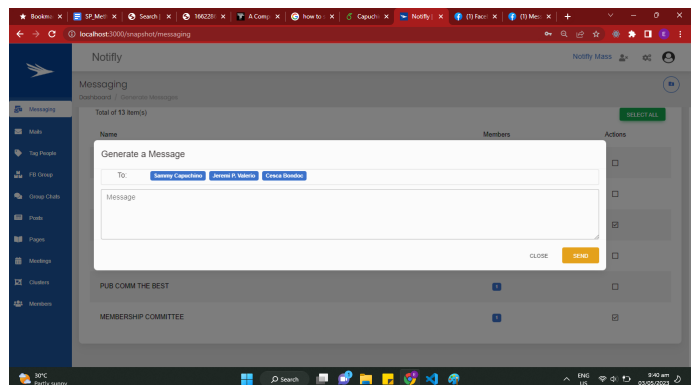

Fig. 5. View Cluster:

Fig. 8. Messaging Page

3) Members: Users may add a member. Each member should have Messenger ID, email address, Facebook name, username, and nickname. Every member can be included inside one or more clusters. A member can be updated, archived, and restored.

5) Mails: Users can send messages to the emails of the selected clusters in the checklist. The message contains the title, date, and content. Each sent emails contain the company/organization signature.
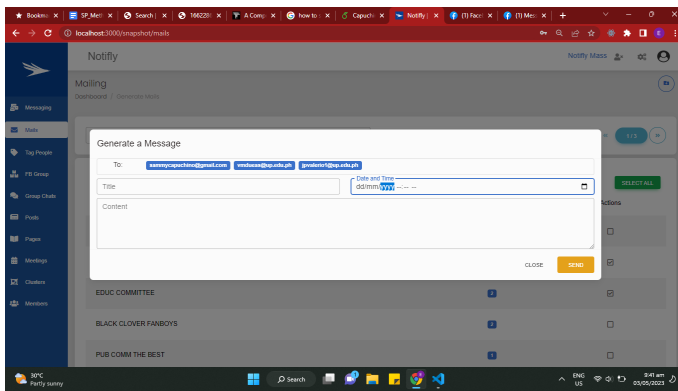
Fig. 9. Mail Page

6) Tag people: Users can tag Facebook accounts in a post or post link. The tagged people is selected through a cluster checklist and the post can be selected through a URL or post list.
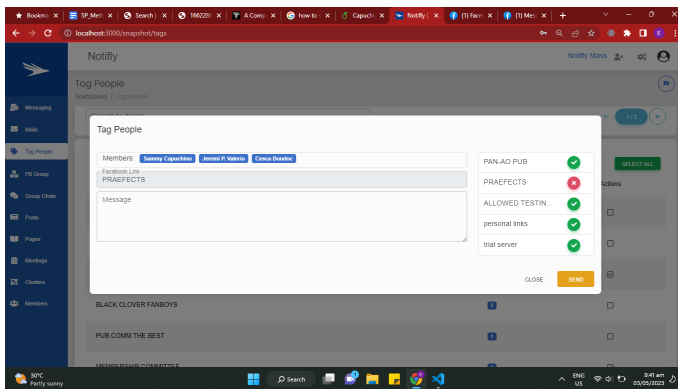
Fig. 10. Tag Page

7) FB Group: Users can send a post to several Facebook groups. Facebook group list is added via providing the several URLs of related groups referenced by a unique group list name.
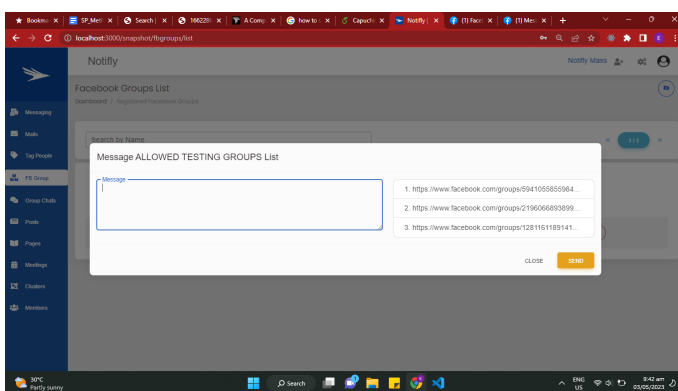
Fig. 11. FB Group Page

8) Group Chats: Users can add, edit, archive, and restore group chat list, which is a list of related Facebook group chats. The group chat list is used in sending uniform messages.
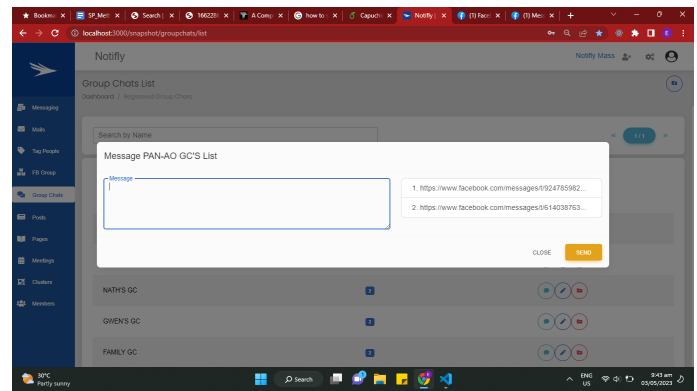
Fig. 12. Group Chat Page

9) Posts: Users can add, edit, archive, and restore a post list. Post list contains unique name and series of Facebook post URLs. Users can like and share post lists.
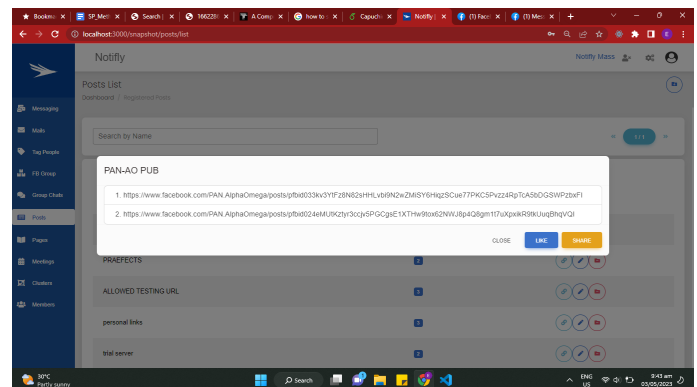
Fig. 13. Like and Share Post
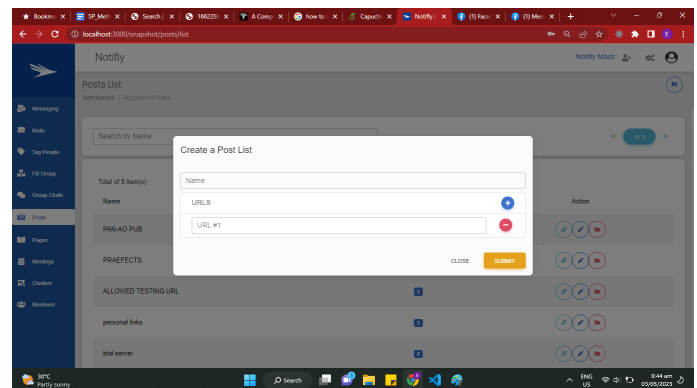
Fig. 14. Add Post List

10) Pages: Users can add, edit, archive, and restore a page list. Page list contains unique name and series of Facebook page URLs. Users can like or follow page lists.
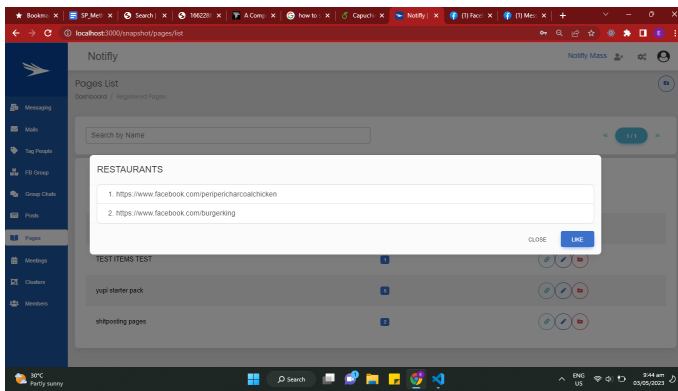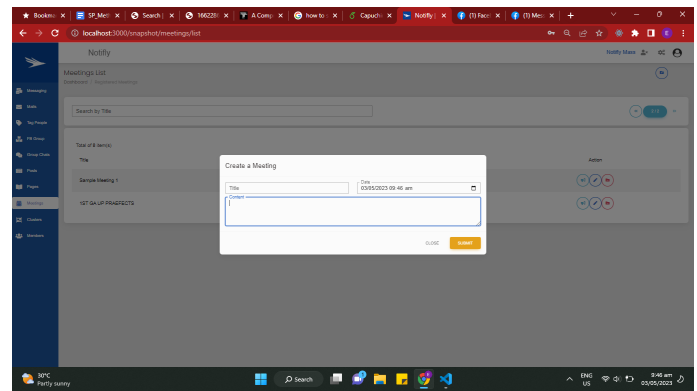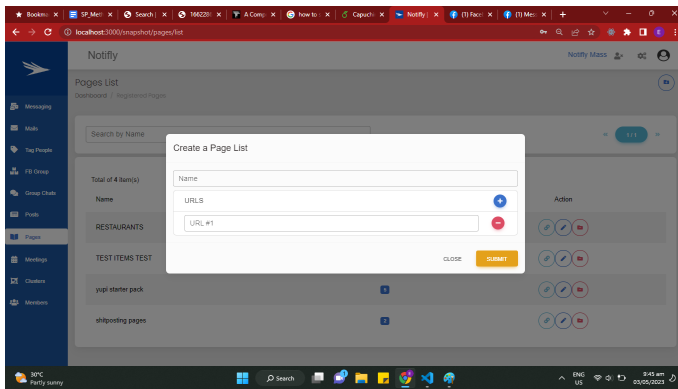
Fig. 15.   Like/Follow Pages

Fig. 18.   Add Meeting

Fig. 16.   Add Page List

11) Meetings: Users can add, edit, archive, and restore a meeting. A meeting contains title, date, and content. A meeting can be sent through email, messenger, and group chats.
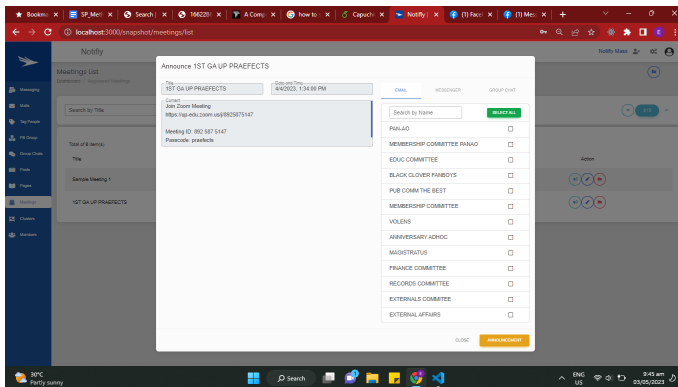

Fig. 17.   Meeting Page

B. System Usability Testing

The web application was tested by 10 college-student respondents from the University of the Philippines - Los Baños, 5 from academic and another 5 from non-academic organizations among different degree programs. This consists 7 male and 3 female participants, ages 20 to 23 years old.

To assess the usability, the 10-item System Usability Scale questionnaire was answered by the respondents. SUS uses Likert-scale, which measures response in a 5-point scale; from strongly disagree to strongly agree. The questionnaires were answered in Google Forms, where the links were sent through email. The respondents evaluated the score in the testing area.

The web application received an overall SUS average score of 83.5%, which is translated to excellent and acceptable experience. The non-academic organization rated the system 79.5% while the academic organization rated the system 87.5%, both of which is translated to excellent and acceptable experience. The respondents were asked to elaborate their observation and evaluation.

Questionnaire number 1 asked if the user would use the system frequently, which garnered an average score of 4.9/5. As administrators of their respective organizations, the users argued that the system is in fact a "platform for persistent notification"

Questionnaire number 2 asked if the user find the system unnecessarily complex, which garnered an average score of 2/5. Few users stated that the input of data in the system specifically the members, needs careful tutorial.

Questionnaire number 3 asked if the system was easy to use, which garnered an average score of 4.6/5. Some users testified that the layout is uniform all throughout the functionalities, which makes the system understandable after frequent use.

Questionnaire number 4 asked if the users think they need a technical assistance when using the system, which garnered an average score of 2.1/5. The users stated that they will only need an assistance from the initial use.

Questionnaire number 5 asked if the functions in the system were well-integrated, which garnered an average score of 4.7/5. The users stated that each modules in the system follows the same format and that all functions were related to each other.

Questionnaire number 6 asked if the users think there were too much inconsistency in the program, which garnered an average score of 1.6/5. A user explained that first-time users may not understand some part of the system.

Questionnaire number 7 asked if the user would imagine that most people would learn the system very quickly, which garnered an average score of 4.2/5. The respondents stated that

the system is very relative to the student organization.

Questionnaire number 8 asked if the user find the system awkward to use, which garnered an average score of 1.7/5.

Questionnaire number 9 asked if the users feel confident about using the system, which garnered an average score of 4.3/5. Some users testified that they fully know how the system works and they are confident in deploying it for their organization.

Questionnaire number 10 asked if the users need to learn a lot of things before they can get going with the system, which garnered an average score of 1.9/5. A user stated that the web application contains a lot of functionalities that needs to be frequently used before familiarity sets in.

V. Conclusion

Notifly is a Facebook and Messenger-integrated collaborative web application tool used for organization's persistent notification system. The system is designed in order to address information dissemination problem inside university college-based organization. The system maximizes the Facebook notification overhead display and Messenger chat head feature. With this, the system attempted to instantly deliver messages and alerts real-time to the users.

The users of the application can add clusters and members in the database. The accounts included in the system are real Facebook and Messenger credentials corresponding to individual students inside the organization. These accounts are included inside the Members. The Members functionalities include add, edit, archive, and restore. The Clusters functionality handles the committee designations. Each cluster contains several member, and a member may belong to one or more clusters. This grouping structure will be used in order to perform automated tasks.

The users may also add meetings for announcements which are sent as messages or emails. The system also cater Page and Post list, which contains related links where the users may like and share the post or like and follow pages.

Automated tasks inside Notifly is used for the persistent notification system. These tasks are Messenger direct messages, group chat messages, tag post, like and share post, like and follow pages, send mail, and announce meetings. These functionalities are available to the users, which are then prompted if the queries were successful.

The web application was evaluated using the System Usability Scale (SUS). With ten respondents, five from academic and five from non-academic organization, the system garnered an average score of 83.5%, which is translated to excellent and acceptable usability. The respondents also provided additional feedback in order to improve the usability of the system.

VI. Recommendation

The major improvement that could be done in the system is to subscribe to the paid platforms for MongoDB (database), cloud server, and NodeMailer (mailing services) for extensive use and additional storage capacity. This will account for the additional users which are expected if the platform is used for commercial purposes.

The respondents provided the following feedback that would improve the functionality of the system. First, the users would like to see tutorials about the navigation of the website. For inputting data such as member and group chat credentials, the user find it helpful if there are pop-up alerts displaying where the data can be collected (ex.: Messenger ID). Users also prefer if all the lists can be sorted in a particular manner (ex.: alphabetical) for easier browsing. Most importantly, the system can be more useful if the announcement of meetings can be done using one click for all platforms.

Another main concern for improvement is the deployment of Selenium functions. The program is designed in order to address spamming concerns, as such, certain time-outs and maximum threshold is strictly observed for system accuracy. The application can be developed by investigating more on the behavior of Selenium functionalities, and how it interacts with Facebook's elements. The system is highly dependent on Facebook's frontend elements, which are hooked and selected in order to perform web driver actions. The users were also prompted about the possibility of headless implementation. Headless implementation is where the browser will not appear on the screen. The users are just prompted with the alert message of status. Half of the respondents prefer thisn implementation.

A major workaround for the system is to fully create the system using Facebook Graph API. This will improve the accuracy of the system. The scope of the functionalities will be enlarged and the system will be more robust in terms of deploying automated queries. Lastly, anti-spamming techniques could further be improved to accommodate large data.

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