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RESEARCH ARTICLE

Development of App-Based E-Board Announcement System with SMS Support

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Abstract

Objectives: This study aimed to design and develop an App-Based E-Board Announcement system with two-way SMS Support and consequently evaluate its level of efficiency and usability in the perception of the respondents. **Methods:** Developmental and descriptive research designs were employed in this study. To evaluate the system's usability and to ensure that the system conformed to the standards set for software development, the researcher used McCall's Quality Model. The researcher also used ISO/IEC 25010 software characteristics to evaluate the level of efficiency. Moreover, the researcher used waterfall model as a system development model during the process of software development. Mean was used to statistically compute the results. **Findings:** Results showed that the level of usability of the developed App-Based E-Board Announcement system with SMS Support has an overall mean of 4.60 which was interpreted as very good. Also, the level of usability was found to be very good by the users in all of the implementation indicators. The respondents were all unanimous in their perception that the developed system carried a high level of usability. Similarly, based on the respondent's feedback, the developed system yielded a mean of 4.70 for its level of efficiency which was interpreted as very good. This simply showed that the respondents were very much satisfied with the efficiency of the developed system. **Novelty:** The study developed a mobile application for sending SMS to the system. The two way SMS communication is a unique version of the study wherein an announcement is sent to the system and displayed on LCD screen and at the same time, the announcement is sent to a specific group of individuals using their cellphone numbers registered to the system as compared to existing E- Boards/Notice Boards that use one-way communication.

Keywords: AppBased; EBoard; Announcement System; SMS; Mobile Phone; Mobile App

1 Introduction

Mobile application (mobile app) is an application system delivered via smartphone or mobile devices. Due to the advanced technology of smart devices, this application has become an important system that facilitates a large number of people to access information efficiently [1]. It is an efficient way to capitalize on the potential of the technology of the mobile device for a business or an organization to be responsive, connected, and stays relevant with their employees and customers. The field of application where mobile apps can be used is numerous. The researcher assesses the readiness and perceptions of faculty members and college students in the use of mobile devices for learning inside and outside the classroom [2]. Another area of application of mobile app is health [3–5] and assistive technologies [6–8] by exploiting the mobiles devices thru web accessible features to monitor the status and aid people with impairments. In the academe, mobile apps are utilized as a medium for teaching and learning [9] as well as information dissemination [10–12].

Global System for Mobile Communication (GSM) is a cellular standard for mobile phone communications to cater to voice services and data delivery using digital modulation where short message service (SMS) has a profound effect on society. Using GSM for displaying SMS on LCD notice boards through wireless communication has been used in many ways. By using GSM networks, it is possible to decode the received SMS on the mobile phone to function in a particular way as necessary [12=18].

The researchers developed an E-Announcement system communication tool that provides the Office of the Student Affairs and student organization a venue to perform internal and external communication among other student organizations [10]. The study [11] proposed an electronic cloud-based architecture for an e-notice board system for Rashtrasant Tukadoji Maharaj Nagpur University and act as a seed model for smart universities in India, which consists of Light Emitting Diode (LED) monitors displaying textual, image, or document notices generated through this system's Android smartphone-based or Web desktop-based applications. Utilizing embedded systems along with GSM module [11–18] improved the old traditional bulletin notice board system with a much faster and efficient electronic modular notice board system which is paperless and reduces physical methods of maintenance and operations. However, the announcement systems cited previously are limited to a one-way communication wherein SMS is only used to send a message to be displayed on the E-Board/Notice Board.

The main goal of this study is to solve the said limitation. Thus, this paper proposes an E-Board Announcement System that will display a message sent by authorized personnel to the E-Board using a mobile app and at the same time send the same message to a specific group of people stored in the database of the system via SMS.

2 Materials and Methods

2.1 Research Design

The study employed developmental and descriptive research designs. To evaluate the system's usability and to ensure that the system conformed to the standards set for software development, the researcher used McCall's Quality Model. The researcher used ISO/IEC 25010 software characteristics to evaluate the level of efficiency.

The researcher also used the waterfall model as a system development model during the process of software development. The phases of this system development include requirement analysis, system design, coding/implementation, testing, deployment, and maintenance. Waterfall Model is the oldest and the most well-known SDLC model. In all the phases, the researcher performed specific activities to achieve maximum productivity and presented it to the user for the refinement of the final product. Figure 1 shows the Waterfall model as the SDLC in this study.

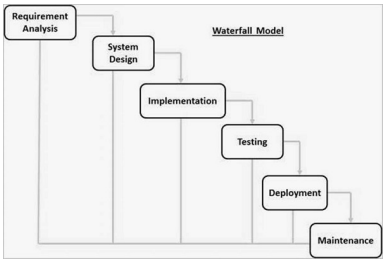

Fig 1. The Waterfall Model as SDLC model used in the study.

2.2 Requirements Analysis

In NIPSC, there was a total population equivalent to 3,362 coming from faculty, staff, and students. To identify the sample size, the researcher used the stratified sampling technique wherein the researcher divides the entire population into different subgroups and randomly selects the final subject from the different subgroups. For the faculty, the researcher selects sixteen (16) out of one hundred fifty-five (155), three hundred twenty-nine (329) students out of three thousand ninety-six (3096), and twelve (12) out of one hundred eleven (111) staff. This group of people was also given a questionnaire based on ISO/IEC 25010 software characteristics to test and evaluate the system.

The sample size was obtained using the formula:

$n = N/1+Ne^2$

where:

n = sample size

N = population size

e = 0.05 (sampling error)

The distribution of the subgroup's final subject was obtained using the formula:

$n1 = \frac{N1}{Nt}(n)$

where:

n = total size of the stratified random samples

Nt = total population

N1 = population size of the first group

N2 = population of the second group

N3 = population of the third group

The following are the evaluators during the initial, expert and user acceptance testing:

Table 1. Actual Distribution of software Evaluators/Respondents

Evaluators	No. of Evaluators
Initial Testing	357
User Acceptance Testing	357
Expert Testing	5

2.3 System Design

The design of the system was based on standard network development techniques for an efficient user interface. Font colors, styles, and sizes as well as background and even whitespaces had been taken into considerations for a good visual appearance. In the development of the system, the researcher used Apache as the webserver, MySQL for the database, and PHP as the server-side scripting language. Thus, the researcher downloaded and installed XAMPP version 7.2.2. Microsoft visual studio 2017 was also downloaded and installed for the SMS module.

2.3.1 Physical Network Topology

It is how they are interconnected with wires and cables, laptops, cell phones, and other devices. Since the developed system was implemented through SMS technology, it was developed to make use of the existing infrastructure of the telecommunication companies as a carrier of Support. The SAS Director as the primary user of the system had direct access to the developed App-Based E-Board Announcement System with SMS Support. The Key Officials as the secondary users send their announcements to the developed system using SMS. A dual GSM-capable modem was attached to the server computer to receive messages coming from cell phones used by the key officials. These messages were verified and validated by the Student and Auxiliary Services (SAS) Director before it was posted on the electronic board and sent support about the announcements to students, faculty, and staff through SMS. Figure 2 shows the physical network topology of the developed system.

2.3.2 Main User Interface

The main user interface is the main window of the developed system that helps the user navigates the system. This form is composed of two menus and six modules. The first menu is the system menu composed of three drop-down menus which are a user, SMS panel, and exit. Clicking the user sub-menu will allow you to add a new user, edit, and delete. The SMS panel sub-menu will show the connection, status, network registration, and signal of the modem. Clicking the exit sub-menu will end

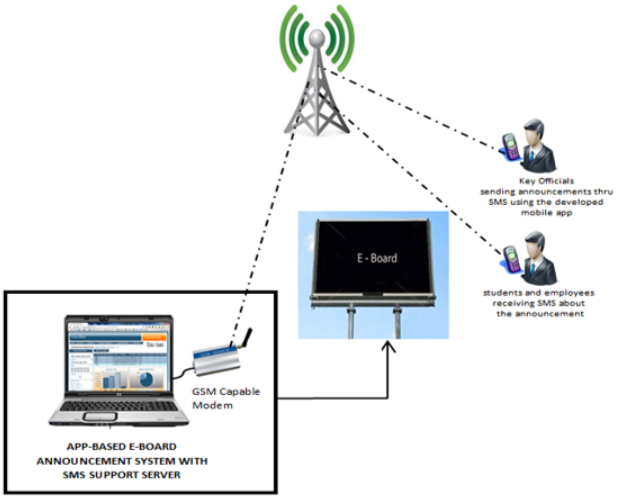

Fig 2. The Physical Network Topology of the developed system

the program. The second menu is the settings menu which is composed of five sub-menus. The first sub-menu under-setting is the DB setting or database settings which display the username, password, and host, localhost means that the Mysql server is located in the local server. The second sub-menu under settings is the SMS settings. This displays the serial port where the GSM modem is connected and the baud rate. The third sub-menu under settings is the font settings. In this sub-menu, you can set the size of font and time interval of display in the E-board. The fourth sub-menu under settings is the clear receive SMS. Clicking this sub-menu will delete all messages received in the system. The last sub-menu under settings is the clear SMS sent. Clicking this sub-menu will delete all messages that were sent to the system. Figure 3shows the main user interface of the system.

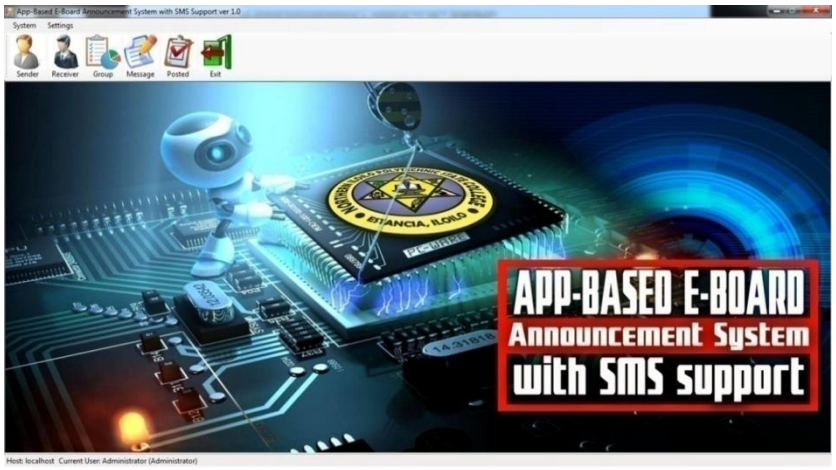

Fig 3. The main user interface of the developed system

2.3.3 Mobile app developed in the study

The Figures below show the mobile app developed by the researcher named (My ApplicationSMS). This mobile app was used by the key officials as the authorized sender of the announcement. This mobile app is easy to install and very convenient to use. The developed system will accept only SMS from the authorized sender by validating the Mobile Identification Number (MIN) and will reject all SMS coming from unauthorized users. Figure 5 is the environment after you press the shortcut icon of the mobile app developed in the study shown in Figure 4. This is where key officials can type announcements and send them directly to the system by pressing the send button.

Fig 4.

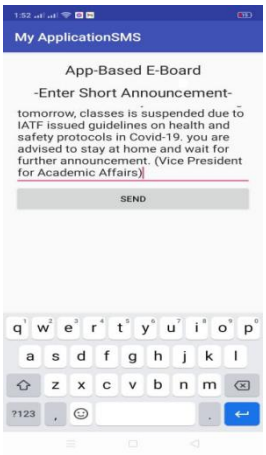

Fig 5.

2.3.4 SMS notification

SMS notification is the message received by employees and students about the announcements. Because of the pandemic and some of the employees are not required to report every day on the campus, the developed system was very useful to them because they are already aware of the announcement by receiving text messages even they work at home status. Also, students are aware of the important announcement in school because they can already receive SMS notifications about the announcement even they are in their homes. Figure 6 shows the SMS notification of the developed system.

2.3.5 E-Board Display

The E-Board Display is where all important announcements for students and employees of NIPSC were displayed. For better visual appearance, the announcement was displayed using a 65" LED screen which was strategically located in front of the Administration building. All the messages were being queued and displayed one at a time on the LED screen. The E-board display is shown in Figure 7.

2.4 Implementation

In computer science, an implementation is a realization of a technical specification or algorithm as a program, software component, or another computer system through computer programming and deployment. In this study, the developed system was coded using an appropriate programming language to implement the designed algorithm and procedures. The researcher used VB.net, a server-side scripting language designed for web development and also used as a general-purpose

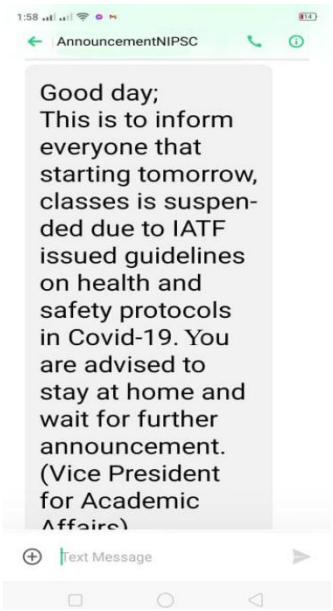

Fig 6. SMS notification of the developed system

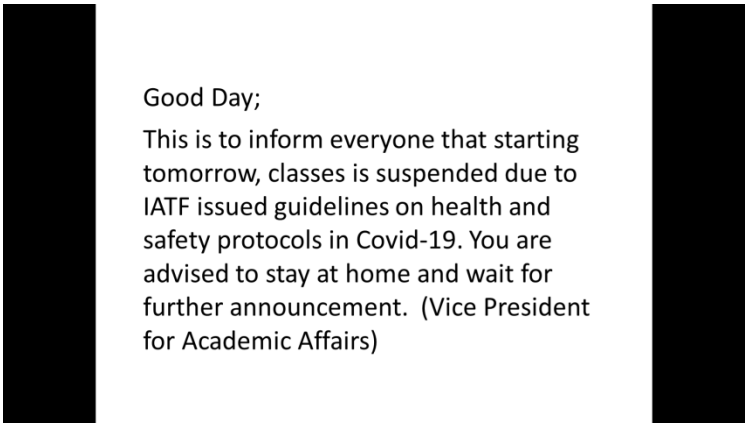

Fig 7. E-Board display of the developed system

programming language. In this stage, the researcher also used a database application for entering and retrieving information from a computerized database. The researcher made sure that the database software was compatible with the programming language used so that it can support a large amount of data for storage. Thus, the researcher used MySQL as database software to store and retrieve the data efficiently. For the android application used in the system, the platform used was the android studio and the programming language was Java.

2.5 Testing

The developed system has undergone a series of testing by experts in the field of study. SAS Director as the primary user, key officials, and students as the secondary user were allowed to use the system. After the testing, the researcher provided a set of questionnaires to the testers to allow them to evaluate the user's experience which includes the user's acceptability and usability of the system.

The result of the evaluation was used as part of the improvement process of the developed system. This research study has utilized a questionnaire that aims to determine the user's level of experience and the overall functionality of the system. The questionnaire was based on McCall's Quality Model for characterizing the quality attributes of the software product. Base on this

model, the researcher was able to design a survey form with corresponding attributes that will describe the overall functionality of the system. The questionnaire was subject to validation by four experts of the field in the study using good and scale criteria. A scale of 1 to 5 was used to identify the level of performance and evaluation of experts in the system.

The following scale was given verbal interpretations, 5 as very good, 4 as good, 3 as average, 2 as fair, and 1 as poor. The data that was used in this study was based on McCall's Quality Model that was incorporated three main perspectives for characterizing the quality attributes of software products.

2.6 Deployment

The deployment phase is the final phase of the Software Development Life Cycle (SDLC) and puts the product into production. After the developed system was tested by the end-users and passes each testing phase, the system was deployed in the office of student affairs at NIPSC, Estancia, Iloilo, Philippines.

2.7 Maintenance

Software maintenance is the process of changing, modifying, and updating software to keep up with customer needs. Software maintenance is done after the product has launched for several reasons including improving the software overall, correcting issues or bugs, boosting performance, and more.

To maintain the functionality of the developed system, the SAS Director, and the staff was trained to be an expert in programming and to enhance their knowledge in error corrections and optimization. Source codes and other important documents were provided to them for their maintenance guide if in case of technical problems that may arise during the operation of the system.

3 Results and Discussion

3.1 Level of efficiency of the developed system in terms of time behavior, resource utilization, and capacity.

The developed system was evaluated for its level of usability in terms of time behavior, resource utilization, and capacity. Software efficiency refers to the highest level of performance of a system that meets specified requirements, user needs, and expectations. Software efficiency requires reducing the number of unnecessary resources used to produce a given output including personal time and energy.

The result showed that the developed system yielded a mean of 4.70 for its level of efficiency which was interpreted as very good. Specifically, the developed system got a mean of 4.65 for its time behavior which was interpreted as very good. For resource utilization, it was perceived with a mean of 4.75 and was interpreted as very good while in terms of capacity, it was yielded a mean of 4.70 and was described verbally as very good. The respondents of the study viewed that the developed system was responsive and showed better performance based on the functional requirements. Further, because the developed system was employed in a network-enabled environment, the resource utilization of computer peripherals such as Central Processing Unit (CPU), Hard Disk Drive (HDD), and Random Access Memory (RAM) meets the minimum requirements of a typical personal computer (PC). Table 2 shows the results on the level of efficiency of the developed system.

Table 2. Respondents' feedback on the level efficiency of the developed system in terms of time behavior, resource utilization, and capacity

Implementation Indicators	Mean	Verbal Interpretation
Level of Efficiency	4.70	Very Good
1. Time Behavior	4.65	Very Good
2. Resource Utilization	4.75	Very Good
3. Capacity	4.70	Very Good

4.21-5.00 (Very Good); 3.41-4.20 (Good); 2.61-3.40 (Average); 1.81- 2.60 (Fair); 1.00-1.80 (Poor)

3.2 Level of Usability of the Developed system in terms of recognizability, learnability, operability, error protection, and interface aesthetics and accessibility

The developed system was evaluated to its level of usability in terms of recognizability, learnability, operability, error protection, and interface aesthetics, and accessibility. Usability refers to the quality of the user experience when using a product and to effectively and efficiently satisfy the end-user.

The results showed that the level of usability of the App-Based E-Board Announcement System with SMS Support has an overall mean of 4.60 which was interpreted as very good. In terms of recognizability, the respondents' echoed that the level of usability has a mean of 4.65 which was interpreted as very good. In terms of learnability, the respondents echoed that the level of usability has a mean of 4.72 which was interpreted as very good. In terms of operability, the respondents echoed that the level of usability has a mean of 4.45 which was interpreted as very good. In terms of error protection, the respondents echoed that the level of usability has a mean of 4.55 which was interpreted as very good while in terms of interface aesthetics and accessibility, it was yielded a mean of 4.63 and was described verbally as very good. The respondents of the developed system viewed that the system was usable because it effectively and efficiently satisfied their needs. Table 3 shows the result on the level of usability of the developed system.

Table 3. Respondents' feedback on the level of usability of the developed system in terms of recognizability, learnability, operability, error protection, and interface aesthetics and accessibility

Implementation Indicators	Mean	Verbal Interpretation
Level of Usability	4.60	Very Good
a. recognizability	4.65	Very Good
b. learnability	4.72	Very Good
c. operability	4.45	Very Good
d. error protection	4.55	Very Good
e. interface aesthetics and accessibility	4.63	Very Good

4.21-5.00 (Very Good); 3.41-4.20 (Good); 2.61-3.40 (Average); 1.81- 2.60 (Fair); 1.00-1.80 (Poor)

4 Conclusions

This study successfully designed and developed a two-way announcement system that delivers efficient and real-time information that could benefit any university when it comes to information dissemination not only for the key officials but to the students and employees as well. The level of efficiency of the developed system in terms of time behavior, resource utilization, and capacity of the proposed system was perceived by the evaluators as "Very Good". This meant that the developed system retrieves and provides real-time information. The response time of the system is very fast and the respondents did not experience any lag when posting the announcement. Further, the system can be installed on a computer with minimal resources and performs well without any technical issues during operation. The level of usability of the developed system in terms of recognizability, learnability, operability, error protection, and interface aesthetics and accessibility was also perceived by the respondents as "Very Good". Key officials of NIPSC can easily publicize their announcement by sending an SMS message and displaying it on the LCD screen strategically mounted in front of the Administration Building. The respondents were able to easily understand and learn the functionalities of the system. According to them, they were able to publish the announcement without any errors. Likewise, the LCD screen displays the announcement legibly. As to the interface design of the developed system, the respondents remarked the system interface to be user-friendly and the color scheme to be pleasant to their eyes.

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