

A WIRELESS DIGITAL PUBLIC ADDRESS WITH VOICE ALARM AND TEXT-TO-SPEECH FEATURE FOR DIFFERENT CAMPUSES

*Mark John P. Lado

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Corresponding Author: Mark John P. Lado; Email: markjohnplado@gmail.com; doi:10.46360/globus.mgt.120211009

Abstract

Adaption of the new technology is a prerequisite for the business's survival and to meet the quality standard. The public address system is widely used in all areas of living; it helps the host speaker to easily disperse the desired messages. This study aimed to develop a wireless digital broadcasting with voice alarm and text-to-speech (TTS) feature that can wirelessly transmit audio signals from the main campus to its satellite campus over long distances. Also, the prototype has a TTS feature that can offer high-quality and stable speech. The main campus is the Colegio de San Antonio de Padua (CSAP) located at Guinsay, Danao City Cebu, Philippines with a satellite campus at Brangay Suba, Danao City, with a distance of not less than four kilometers and not greater than five kilometers from the main campus. The researcher used the descriptive developmental method of research as the systematic study of designing, developing, and evaluating programs that must meet the criteria of internal consistency and effectiveness. The rapid prototyping model was used during the system development while the criteria in McCall's Factor Model were used to test the system according to its usability, applicability, and efficiency.

Keywords: Public Address System, Wireless, Text-to-speech, Digital Broadcasting, Audio Signals, CSAP.

Introduction

A public address system (PA system) is an electronic system comprising microphones, amplifiers, loudspeakers, and related equipment [8]. Presently, digital PA systems have been broadly adapted in numerous places, such as sports arenas, public transportation vehicles, offices, shopping lobbies, campuses, manufacturing plants, air terminals, and intelligent buildings.

The existing PA systems of the two campuses of Colegio de San Antonio de Padua (CSAP) are not linked together. Each campus has an independent or standalone PA system. Thus, when there is a need of disseminating a public address, it consumes much time and effort to relay the concerned information. For the aforementioned reasons, this study aimed to develop a wireless communication prototype tool that addresses the gap of the current condition of the broadcasting system of CSAP and also that will help the school community to disperse a message from the main campus to the satellite campus simultaneously using wireless technology.

In other words, this study aimed to develop a wireless digital public address with voice alarm and text to speech feature that is capable to transmit and receive radio signals over a long distance. It will ensure to amplify in a wide range of audience with the consistency and accuracy in terms of the tone, pronunciation, diction with the help of the TTS feature. This study also aimed to develop a prototype that has control software that can able to set the date and time of the pre-recorded messages for loop broadcasting and also recognize inputted text and convert it into speech. The additional feature for the proposed prototype is that the control software has a sentence fragment checker for grammar corrections to ensure the quality of service. This study also determined the applicability, usability, and efficiency of the system in terms of its function and purpose.

In addition, emergency broadcasting is also the major considered functionality for modern digital PA systems [4]. With that point of view, by the help of this proposed prototype, many lives will be saved from any form of shortcomings and catastrophic circumstances wherein the pre-recorded messages will be dispersed to guide on

safety protocols or the safety measures that need to be executed. Moreover, it will be easier to determine in classifying the type of emergency arising rather than hearing a siren inside the campus. Especially nowadays, everything has been so blurry and unpredictable in terms of catastrophic and Acts of God's circumstances. So, we must be properly guided through a solidified protocols and rules which this proposed prototype can be a great help.

Materials and Methods

System Design

This study used the Rapid Application Development (RAD) of System Development to accomplish the desired objectives.

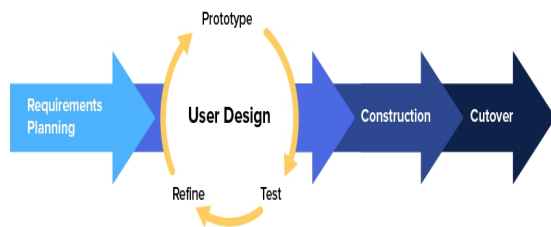


Figure 1: Rapid Application Development

Figure 1 showed the RAD, it is an iterative software development methodology aimed at improving the analysis, design, and development of proposed systems until a satisfactory prototype is finally achieved. With rapid application development, developers can make multiple iterations and updates to software rapidly without needing to start a development schedule from scratch each time.

Define the Requirements

The researcher collected the needed data about the existing problem through an interview. The researcher also determined the technical requirements to be used in implementing and designing the prototype.

Prototype

The design architecture of the proposed wireless digital PA system with voice alarm and TTS features for different campuses are shown in Figures 2 and 3. The basic architecture of the proposed wireless digital PA system consists of a microphone, PA controller, loudspeaker, long-range audio transceiver, and dedicated control software. The hardware is adapted with the existing tools like the microphone, audio amplifier, loudspeaker, and transceiver while the dedicated control software is developed to its purpose to meet

the requirements. Figure 2 showed the proposed diagram of the CSAP main campus, it uses a dynamic microphone as an input device, an audio amplifier with dedicated control software that acts as a PA controller, a loudspeaker that will act as an output device, and a long-range audio transmitter to send radio signals to the CSAP satellite campus.

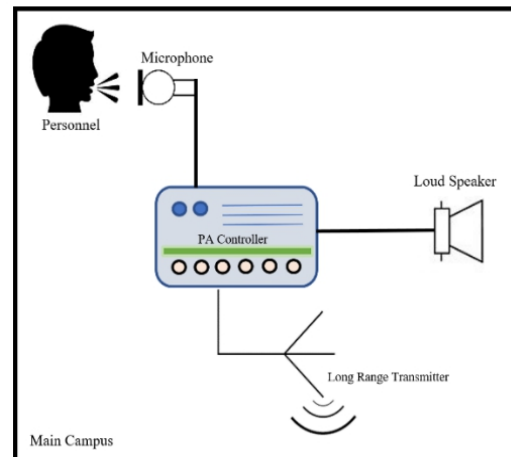


Figure 2: CSAP Main Campus

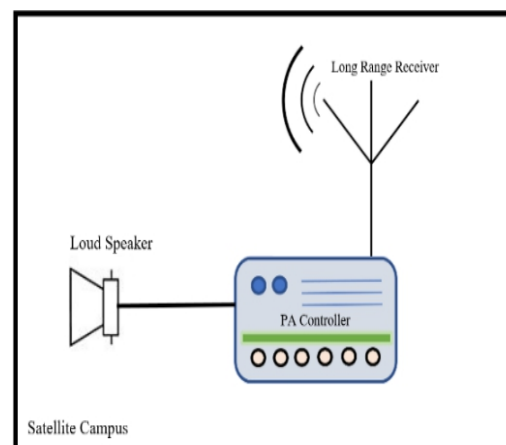


Figure 3: CSAP Satellite Campus

The diagram of the CSAP satellite campus is shown in Figure 3, it has a long-range receiver to obtain the radio signals coming from the CSAP main campus, it also uses an audio amplifier to amplify the audio signals coming from the CSAP main campus, and also has a loudspeaker that will act as an output device. Moreover, the architecture of the CSAP satellite campus can operate without embedding a control software.

The developed dedicated control software is user-friendly which is shown in Figures 4 and 5. The TTS broadcasting function supports male and female speaker selection and has sentence

fragments to check the grammar of the inputted text to ensure the quality of service.



Figure 4: Main Execution Screen

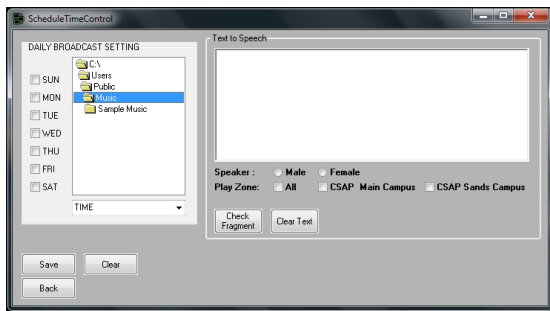


Figure 5: Settings Execution Screen

Figure 4 showed the main execution of the control software with the TTS function. The user can temporarily type text messages that can be broadcasted immediately. Also, by selecting the checkboxes the user can select from which zone the messages will be delivered. In the main execution screen, the emergency buttons are present and can be manually enabled if in case of a catastrophe, but it can also effectively integrate with existing solutions such as access control, burglar system, intercom, electrical power management, environmental control system, and telephone broadcasting.

Figure 5 showed the settings execution screen with the TTS function. It provides the settings for daily routine, and special events music broadcasting such as festivals, exams, works, and other related activities. Another features for the control software is that the user can add pre-recorded messages (mp3 and mp4 format), can directly type contents on the text box, can select the speaker host like male or female, can select play zone and pick the desired time and date to activate loop broadcasting, and once satisfied, the user can save the settings by clicking the save button.

Prototype Evaluation

The developed prototype was tested by IT experts for the functionality to see if the objectives are met. The prototype was carefully examined, evaluated,

and tested for consistency and accuracy in terms of the tone, pronunciation, diction, and sentence fragments of the TTS feature, and the efficiency in terms of sending radio signals to its satellite campus. The developer then fixed the minor bugs in the system to make sure that everything will work and function according to its purpose.

Refinement

Based on the findings and result of the initial testing of the prototype, the developer carefully made some refinements of the PA control software and another round of adjusting in the frequency band of the long-range transceiver. All recommendations from the IT experts and the CSAP personnel who participated in the initial testing were taken and applied to the final testing of the prototype.

Respondents of the study

The respondents of the study are members of CSAP Personnel.

Table 1: Summary of Respondents

CATEGORIES	SAMPLE SIZE
CSAP Personnel	50
Total	50

Probability Sampling Methods

Table 1 showed the summary of respondents. The researcher used simple random sampling, assigned a number to every employee in the company database, and used a random number generator to select 50 numbers.

Results and Discussion

After the series of tests conducted and detailed evaluation of the system, the results are as follows:

Table 2: Evaluation Result Given by The Respondents

AREA	GRAND MEAN	VERBAL INTERPRETATION
Usability	4.80	Very Good
Efficiency	4.87	Very Good
Applicability	4.90	Very Good

Five-Point Likert Scale: 4.21 – 5.00 Very Good, 3.41 – 4.20 Good, 2.61 – 3.40 Average, 1.81 – 2.60 Poor, 1.00 – 1.80 Very Poor.

Table 2 showed that the developed prototype is efficient in sending real-time audio frequency to the satellite campus; the respondents rated the prototype with a grand mean of 4.87 interpreted as very good. In terms of usability, the system got a rating of 4.80 while the prototype applicability to

the CSAP was rated 4.90 also interpreted as very good.

Prototypes Usability

The control software of the developed prototype is user-friendly and easy to operate. The user can easily navigate and set messages by typing and converting it into a speech with the help of the TTS feature and sentence fragments.

Prototypes Efficiency

The developed prototype is very efficient; it simultaneously disperses a public address in all campuses, provides high quality and stable pronunciation with the help of the TTS feature, and it also provides secure and accurate data transmission into its satellite campuses.

Prototypes Applicability

The developed prototype is very applicable in terms of the daily operation of the CSAP. It provides accurate speech and real-time delivery on the daily routine public addresses like hourly bell alarm and other special events broadcasting. This will be a great help to the CSAP community once installed and utilized.

Table 3: Evaluation Result Given by The Respondents

Criteria	Mean	Verbal Interpretation
Correctness	4.73	Very Good
Reliability	4.74	Very Good
Efficiency	4.87	Very Good
Integrity	4.84	Very Good
Usability	4.80	Very Good
Maintainability	4.79	Very Good
Flexibility	4.87	Very Good
Testability	4.81	Very Good
Portability	4.86	Very Good
Reusability	4.95	Very Good
Interoperability	4.82	Very Good
Total Mean	4.83	Very Good

Table 3 showed the aftereffect of the system evaluation utilizing the standards in McCall's Factor Model. This model classifies all software requirements into 11 software quality factors. The 11 factors are grouped into three categories – product operation, product revision, and product transition factors. The previously mentioned criteria determined the degree to which the developed prototype and system conformed to the norm regarding its interface, highlights, characteristics, and control and instruments. The general exhibition of the created prototype is entirely astounding with a general rating of 4.83 which implies Very Good.

Conclusion and Future Scope

In this paper, the wireless digital public address with voice alarm and text-to-speech features for different campuses has been proposed. It is easy to operate and has user-friendly features that can help the CSAP personnel to easily operate the control software. It supports a long-range transmission using real hardware implementation like radio frequency transceivers. The male and female voices are provided for TTS broadcasting to achieve high quality and stable voice broadcasting to the target campuses. Also, the control software has a sentence fragment checker for grammar corrections. This system will help the school community to disperse a message from the main campus to the satellite campus simultaneously using wireless technology, and it will also help lessen the time and effort to relay the concerned information.

Further study may be conducted to improve the system design and the functionalities of the developed prototype and more languages of TTS will be provided.

Conflicts of Interest

The author declares there are no significant competing financial, professional, or personal interests that might have influenced the performance or presentation of the work described in this manuscript.

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