Intelligent Agent Using Artificial Neural Network for E-Service of Bureau of Fire Protection

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ABSTRACT

The main purpose of this study is to design and develop a system software with intelligent agent using artificial neural network for the Bureau of Fire Protection to streamline the process for the application of fire safety certificates and to provide quality public service. Embedded on the system are the intelligent agent, artificial neural network, Information and Communication Technology, and Service quality dimensions which can provide prompt services for the applicant of fire safety certificates. A modified service quality dimension scale was used to assess the system. The result of the assessment shows a significant improvement on delivering quality public service. The use artificial neural network and intelligent agent on the system is very effective. The advancement on the technology proved that the study could minimize the number of processes and can provide quality public service in applying fire safety certificates and it is capable to communicate to the applicant of fire safety certificate using artificial neural network. It also provides information, notification and generate report in real time.

Key words: artificial neural network, Bureau of Fire Protection, intelligent agent, service quality.

1. INTRODUCTION

The design of high-quality electronic service for the government [1] plays an important role in the delivery of essential government services [2]. The service quality dimension such as reliability, security, efficiency, and responsiveness are repetitively found to be crucial for the adoption of front-line services and online services [3], [4] of the government. Providing quality government service for the citizens is considered as a strategy for the attainment of efficient government [2]. In the study of Hamari and Jarvinen (2011) there is great demand for the basic services for the front-line service. Also, Hamari and Keronen (2016) discuss that front-line service developers must face the problem on how to design a high-quality frontline service for the government.

In the Philippines, all government agencies and offices providing frontline services are directed to conduct regular studies and evaluation to improve their transaction systems, procedures and re-engineering their transaction process to minimize the bureaucratic red tape and processing time (Republic Act No. 9485, June 02, 2007). In the year 2000, the computerization of government agencies was approved in the Executive Order No. 265 adapting the Government Information System Plan (GISP). It is the framework in designing government system software. This will serve as a guide for the computerization of government agencies. This will serve as an outline for the automation of key government operations and vital frontline services for effective governance (EO No. 265, 2000).

The Bureau Fire Protection (BFP) is one of the public sectors, which provides services that deal in the prevention and suppression of destructive fires. In the Fire Code of the Philippines (RA 9514) BFP is responsible for the issuing Fire Safety Inspection Certificate (FSIC) and Fire Safety Evaluation Certificate (FSEC) to the applicant within his jurisdiction. The BFP issues these certificates upon compliance of the fire safety requirements. The said fire safety certificates are pre-requisites for the issuance of Philhealth Accreditation for Hospital, DOH License to Operate, Occupancy Permit, Permit to Operate, Mayor's Business Permit and other permit and/or licenses issued by agencies both government and private. The process of application and approval of fire safety certificate is complex, and it required multiple number of processes that will cause delay in issuing the said government certificate. Lacking transparency about the status of the applicant of the FSC, determining the amount of fees, inspections, and other information that the applicant of fire certificate must know.

Putting the advancement of technology in the government service of the Philippines will help the public administrators of the traditional administrative organizations to improve their frontline service [7]. The purpose of the study is to design and develop system software with intelligent agent using artificial neural network for the Bureau of Fire Protection to streamline the application of fire safety

certificates and to provide quality public service. Embedded on the system are the intelligent agent, artificial neural network, Information and Communication Technology, and service quality dimensions which can provide prompt services for the applicant of fire safety certificates. A modified service quality dimension scale was used to assess the system. The result of the assessment shows a significant improvement on delivering quality public service. The use of artificial neural network and intelligent agent on the system is very effective. The advancement on the technology proved that the study could minimize the number of processes and can provide quality public service in applying fire safety certificates and it is capable to communicate to the applicant of fire safety certificate using artificial neural network. It also provides information, notification and general report in real time.

2. DESIGN AND METHODOLOGY
2.1 Data Gathering Procedure

The researchers used interview and questionnaire in the data gathering. Interview was used to verbally collect data thru the respondents regarding the existing process of the existing system and their experiences, and comments on applying fire safety certificate. Nine (9) personnel of BFP in NCR was initially interviewed and forty (40) applicant were also interviewed to determine the process of frontline services of BFP-NCR.

The collected data in the interview was used to design and develop an Intelligent Agent using Artificial Neural Network for the E-service of the Bureau of Fire Protection. The developed system of Intelligent agent using Artificial Neural Network was implemented in selected BFP branches. To determine the response of the applicants of fire safety certificates regarding the developed system of Intelligent Agent using Artificial Neural Network for E-service of Bureau of Fire Protection the researchers initially distributed two hundred questionnaires (200) to the respondent. One hundred seventy-nine (179) were retrieved and these were all used in the analysis.

Table 1: Indicators per Service Quality Dimension

Determinant	No.	Indicators
A.Reliability	1	Ability to orderly accommodate applicant
	2	Ability to present information
	3	Ability to provide accurate information
	4	Ability to assist applicant from additional queries
	5	Ability to gather data from internal and external
	6	Ability to process applicant transaction with the standard
	7	time duration Ability to notify the applicant regarding their application status
	8	Ability to release application results on promise date
	9	Ability to satisfy overall expectation
B. Responsiveness	1	Ability to inform applicants on the requirements needed
	2	Ability to provide prompt service on the applicant
	3	Ability to extend help to the applicant
	4	Ability to responds on customer needs
	5	Ability to assist applicant on real tine
C. Communication	1	Ability to inform applicants of the requirements of the services
	2	Ability to inform applicants of the status of their application in a prompt manner
	3	Ability to provide applicants to get updated status on their application
	4	Ability to provide accurate report
D. Tangibles	1	Ability to adequate visually appealing facility
	2	Ability to generate necessary forms
	3	Ability to provide valid report

Table 1 shows the Indicators per service quality dimension. The modified questionnaires of Service Quality Dimension from (Parasuraman, A., et al, 2005) were used to measure the following variables based on the determinants of service quality dimension namely: 1. Reliability, 2. Responsiveness, 3. Communication, and 4. Tangibles.

Table 2: Service Quality Dimension Rating

Scale	Range	Descriptive Rating
5	4-50 – 5.00	Very Effective
4	3.50 – 4.49	Effective
3	2.50 – 3.49	Moderately Effective
2	1.50 – 2.49	Ineffective
1	1.00 – 1.49	Very Ineffective

Table 2 shows the service quality dimension rating. The responses in the questionnaire used the five-points Likert scale where 1 is Very Ineffective, 2 is Moderately Ineffective, 3 is Moderately Effective, 4 is Effective, and 5 is Very Effective.

2.2 Design of Intelligent Agent using Artificial Neural Network for E-service of Bureau of Fire Protection

In designing an intelligent agent using artificial neural network for E-service of BFP the researchers embedded the artificial neural network in the system process.
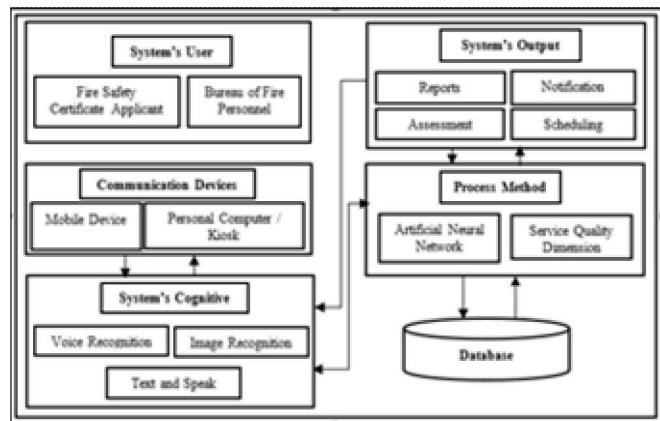

Figure 1: Intelligent Agent using Artificial Neural Network for E-Service of Bureau of Fire Protection

Fig.1 shows that the system has two users the fire safety applicant and personnel of BFP. Both users can use any of the following: mobile devices, personal computer or kiosk located on the BFP branches to communicate to the system and input the data requirements of the system. Using the System's Cognitive the intelligent agent has a capability to communicate to the users. In the system process embedded is the artificial neural network. The role of artificial network on the system is to automatically send notification to the fire safety applicant regarding on the status of their application, automatically provide assessment fee, schedule for inspection and schedule of inspector and needed reports.

2.3 Artificial Neural Network

The researchers embedded the artificial neural networks algorithm in the process part of the development of system. The algorithm of Artificial Neural Network as follows: [9].

1. Assign Random weights to all the linkages to start the algorithm.
2. Applying the inputs and the (Input to Hidden node) linkages find the activation rate of Hidden Nodes.
3. Applying the activation rate of Hidden node and linkages
   Output, find the activation rate of Output Nodes.
4. Determine the error rate at the output node and calibrate all the linkages between Hidden Nodes and Output Nodes.

5. Applying the weights and error found at Output node, cascade down the error to Hidden Nodes.
6. Recalibrate the weights between hidden node and the input nodes
7. Do the process till the convergence criterion is met
8. Applying the final linkage weights score the activation rate of the output nodes [9].

The artificial neuron or node multiplies each of these inputs by a specific weight. Then it adds the product and passes the sum to an activation function. The equation of artificial neural network is shown in equation 1.

$$f(x \cdot w) = \theta(x \cdot w) = \theta \left(\sum_{i=1}^{p} (x_i \cdot w)i \right) \quad (1)$$

Equation 1 represents the neuron vectors where variables x is for input and variable w is for weight, and p is for the inputs into the neuron. The activation function is denoted by the Greek letter (phi). The process produces a specific output from a neuron.

2.4 System Development

For the development of Intelligent Agent using artificial neural network for E-service of Bureau of Fire Protection the following software was used Bootstrap, HTML, JS, JQuery, and CSS to design the website for BFP.

CodeIgniter (PHP), and MySQL DB was used in the back end of the system.

Tracking.js is used in face detection in this study. Web Speech API is used in text to speech and speech recognition and Text API is used in sending of notification to the client.

2.5 Simulation Training Process of Intelligent using Artificial Neural Network for E-service of BFP

Table 3: Simulation Training Process

Learning Coefficient = 0.50									
Input Bias	Input	Weighted Weight of Bias	Weighted Weight of Input	Net (Weighted Sum)	Input Neuron (Y)	Desired Output	Change Weight in Input Bias	Change Weight in Input	No. of Iteration
1	0	1	1	1	1	0	-0.5	0	
1	1	0.5	1	1.5	1	1	0	0	First Iteration
1	1	0.5	1	1.5	1	1	0	0	
1	1	0.5	1	1.5	1	1	0	0	
1	0	0.5	1	0.5	1	0	-0.5	0	
1	1	0	1	1	1	1	0	0	Second Iteration
1	1	0	1	1	1	1	0	0	
1	1	0	1	1	1	1	0	0	
1	0	0	1	0	1	0	-0.5	0	
1	1	-0.5	1	0.5	1	1	0	0	Third Iteration
1	1	-0.5	1	0.5	1	1	0	0	
1	1	-0.5	1	0.5	1	1	0	0	
1	0	-0.5	1	-0.5	0	0	0	0	
1	1	-0.5	1	0.5	1	1	0	0	Fourth Iteration
1	1	-0.5	1	0.5	1	1	0	0	
1	1	-0.5	1	0.5	1	1	0	0	

Table 3 shows the computed value for single input neuron. Since the researchers used sigmoid equation to train the intelligent agent the learning coefficient used is 0.50. There are 4th alteration processes before the intelligent agent learns the process. According to Magnier and Haghighat (2010), the number of iterations stops if the input neuron will be the same with the desired output neuron.

3. RESULTS AND DISCUSSION

The purpose of the study is to design a system embedded the artificial neural network for the bureau of fire protection, to help the front-line service to provide quality government service, and to provide real time and accurate information to the applicant for fire safety certificate.

3.1 Results of System Design
The information gathered from the interview from the personnel and applicant of fire safety certificate was used to design the Intelligent Agent using Artificial Neural Network for E-service of Bureau of Fire Protection.
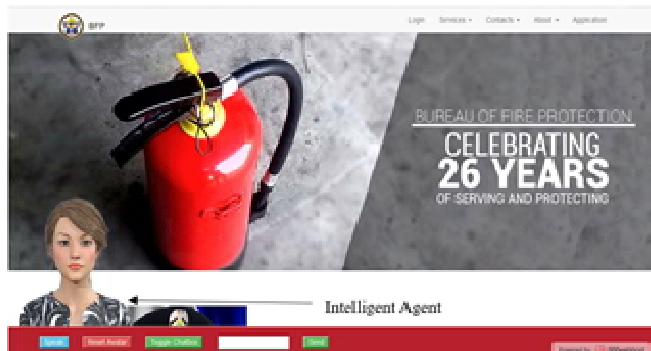

Figure 2: Home Page of Intelligent Agent using Artificial Neural Network for E-Service of Bureau of Fire Protection

Figure 2 shows the home page of Intelligent Agent using artificial neural network for E-serve of Bureau of Fire Protection.

The designed website has a capability to communicate to the applicant of fire safety certificate using text and voice.

In the home page avatar is present to assist the applicant of fire safety certificate. Log-in page contains the employee login and fire safety applicant login. Application module is divided into New Application and Renew Application. Service module contains other services of Bureau of Fire. The intelligent agent is also ready to answer the inquire of the applicant regarding the application and requirements for fire safety certificate.
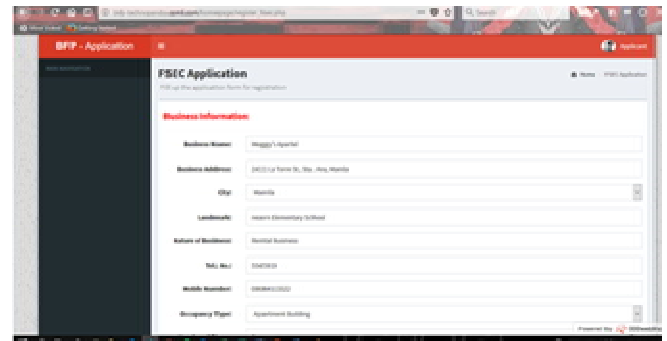

Figure 3: Online Application Form for Safety Certificate

Figure 3 is a fire safety application form. Applicant can now apply anywhere using their mobile device or personal computer for their application of fire certificate instead of visiting the branch of BFP.
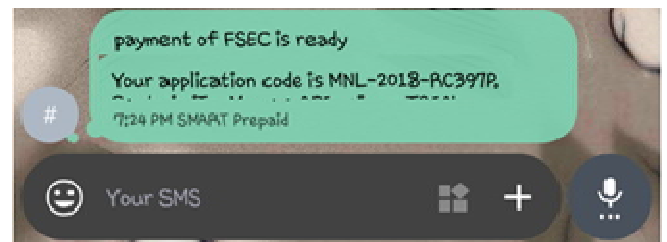

Figure 4: Real Time Notification from the System

Figure 4 present some notification that the applicant will receive during the processing of their application of fire safety certificate.

The fire safety applicant will automatically received notification from their email address and mobile number once they already fill-up the application form. They will continue to received the notification up to the releasing of their fire safety certificate online.

3.2 Results of Service Quality Dimension
Intelligent Agent using Artificial Neural Network for E-service of Bureau of Fire Protection was evaluated using the service quality dimension.

Table 4: Summary of Result of Service Quality Dimension

Determinant	Rating	Remarks
Reliability	4.90	Very Effective
Responsiveness	4.04	Effective
Communication	4.68	Very Effective
Tangibles	4.53	Very Effective

Table 4 shows that except for the provision of Responsiveness which was to be Effective for the rest of determinant Reliability, Communication and Tangibles the respondents perceived the intelligent agent with artificial neural network as Very Effective.

4. CONCLUSION

The Intelligent Agent using Artificial Neural Network for the E-service of Bureau of Fire Protection for the processing of the application for fire safety certificates is necessary. Based on the summary result of the service quality dimensions the system provide quality public service to the applicant of fire safety certificates.

The application of advance technologies proved that the designed system with artificial neural network is capable of learning on its own. It has a capability to process the transactions by its own using the artificial neural network and memory engagement.

However, the demand of memory allocation became higher. The researchers recommend the use of other machine learning algorithm to solve this problem.

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