

BILINGUAL FEEDBACK MANAGEMENT SYSTEM FOR FRONTLINE SERVICES WITH SENTIMENT ANALYSIS USING NAÏVE-BAYES ALGORITHM

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ABSTRACT

The purpose of this research is to develop a feedback management system that uses a modern approach of technologies to aid the existing feedback management system used in the university. The study employed Sentiment Analysis using Naïve-Bayes Algorithm which was used in determining the polarity of the customers' feedbacks or suggestions. In order to come up with an effective and reliable system, the researcher adopted the incremental software development model as software methodology, wherein it delivers a series of releases, called increments. It progressively provides more functionality for the customer as each increment is delivered. One hundred eight (108) customers including seven office heads and one quality management staff were chosen as the respondents of the study. Based on the findings, the developed feedback management system (mobile and web applications) was effective in terms of its overall ease of use, portability and functionality for it received a respectable rating from all respondents. It also showed that the system has passed the overall criteria of its technical quality as well as it eliminates the identified common problems encountered using the existing system. Likewise, the system provides performance reports of each office to determine which among the offices are performing well based on feedbacks. Significantly, this innovation will be an effective feedback mechanism tool in the University to address the concerns of the customers and other stakeholders and provide possible merits and rewards to performing offices.

KEYWORDS – Feedback Management System, Sentiment Analysis, Naïve-Bayes Algorithm, Feedbacks

INTRODUCTION

Technology has been dominating man's lives for decades. Every aspect of man's lives is being influenced by technology. From the invention of fire until today's inventions are parts of the technological era in the Philippines. The integrations of technologies in transportation, education, commerce, and communication are very visible in every man's eyes. These kinds of technologies help achieve man's satisfaction.

Man's satisfaction is indeed unattainable. This saying emphasizes that people nowadays are always seeking for new things instead of being satisfied with the things that he already had. Buying kinds of things like cell phones and even receiving services from service providers are the things that the person is really hard to be satisfied. Being unsatisfied with such items or services, they tend to complain in forms of face-to-face, telephone call conversation or writing or sending feedbacks. Other organizations use other mechanisms in gathering feedbacks, one of which is through feedback box.

Feedback box is considered to be as the traditional way of collecting feedback from a specific customer. This works using a survey form that will be filled out by the customer and then dropped in the box. But this feedback/suggestion box is said to be failing as accords to who claim that suggestion boxes are an input-only system. The staff drops their ideas in the box and receive no immediate feedback (often, no feedback at all). This apparent lack of interest in their ideas diminishes their desire to contribute, and the suggestion box fails. Additionally, assuming someone does open the box to read the ideas, it is considered an inability to work collaboratively with the person who submitted the idea and the people who can implement it. This lack of communication is the final nail in the suggestion box coffin [1]. And because of these issues, the researcher decided to develop a feedback management system.

Feedback Management System (FMS) is a system that handles the customer feedbacks or customer experience. This type of system is created to connect their transactions from their customers to avoid the financial burden on the

business due to bad reviews and unawareness of customer's sentiment until it is too late. It is also a system that helps the management on how to improve their service. To satisfy the customers is the ultimate goal of the frontline service offices. These types of offices must also know the sentiments or opinions of their customers. And nowadays, there is a trend in the technology industry that is used in opinion mining, it is called sentiment analysis.

Sentiment Analysis (SA) is the process of analyzing and summarizing opinions. It is a type of natural language processing for tracking the moods and sentiments of the public about a service, product or topic and the application of Natural Language Processing (NLP), computational linguistics, and text analytics to identify and extract subjective information in source materials such as those discussions about certain products and services [2]. This kind of technology is widely implemented in social media platforms such as Facebook, Twitter etc. A feedback management system with sentiment analysis is a system that will give a large impact on quality service in a certain office. This type of feedback management system can be also implemented in state universities such as Batangas State University ARASOF-Nasugbu.

Batangas State University ARASOF-Nasugbu, as a leading university in the region, offers high-quality education to its students. The university also maintains its integrity and reputation in giving a quality of service to its students, customers, and other stakeholders. Given the fact that the university has different offices that provide frontline services to its customers, it must also consider the satisfaction rate of its services as its ultimate goal is to give a quality of service. The university has an office that manages all the frontline servicing offices, the Quality Assurance Office (QAO).

However, the researcher observed that the existing setup of feedback management system used by the QAO in feedback gathering is through the traditional feedback box. The researcher was determined to help the Quality Assurance Office as well as the frontline service offices in facilitating and continuously improving the quality of service that they will provide to their customers. The researcher came up with the idea of creating a web-based feedback management system with the use of sentiment analysis to aid the existing setup of the feedback management system of the university. This study aimed to develop and evaluate the feedback management system that will aid the existing feedback management system in the university. It aimed to help the customers to have a simple yet efficient feedback mechanism tool to evaluate the service provided by the offices they visited. It also aimed to help the university in performing statistical analysis of the customer satisfaction marks of every office, feedback collection and generation up to distribution of reports.

LITERATURE REVIEW

Blog Comments Sentence Level Sentiment Analysis for Estimating Filipino ISP Customer Satisfaction

The study conducted in 2015, entitled as "Blog Comments Sentence Level Sentiment Analysis for Estimating Filipino ISP Customer Satisfaction" was developed in a web-based system that analyzes the sentiment in each blog and comments of the customer of Internet Service Providers (ISPs) in the Philippines. The study focuses on automated opinion retrieval from blogs and comments to estimate the satisfaction of the three main Filipino ISPs. This system also uses different techniques in extracting useful information from textual data such as Automatic word seeding, N-gram tokenization, stemming and other sentiment analysis (SA). Furthermore, the researchers studied and experimented bag of words and ruled-based method in identifying the polarity of each blog and comments of the clients. In addition, they also used Naïve Bayes (NB), Support Vector Machine (SVM) and pre-processing features such as stopwords and stemmer which resulted in the increase of performance of the automated classifier. The said techniques automatically determined the sentiments of blog sentences [3].

Adoption of Opinion Mining in the Faculty Performance Evaluation System by the Students Using Naïve-Bayes Algorithm

In 2016, a group of researchers conducted a study about "Adoption of Opinion Mining in the Faculty Performance Evaluation System by the Students Using Naïve Bayes Algorithm" that promotes adoption of opinion mining in the faculty performance using Naïve Bayes Algorithm. This study helped the school administrator in identifying the strengths and weaknesses of each faculty members based on the textual evaluation made by the students whether it is written in English or Filipino language. The result of the evaluation can also be represented into graphical form with the percentage of positive and negative feedback. Based on the result of the survey conducted by the researchers, this

system can be a great help to the school administrator in immediately identifying the positive and negative feedback of each student. Thus, the researchers also implied that the school administrator and educators can be more aware of the sentiments and concern of the students. In addition to the output given by the system, it could be also used as a basis for merit, awards and/or promotion of the faculty members [4].

Classifications of Emotions Expressed by Filipinos through Tweets

The study entitled “Classifications of Emotions Expressed by Filipinos through Tweets” is conducted by Pinpin which attempting to classify the emotions of the Filipinos expressed through tweets. Based on the researchers' findings, there are seven basic states that were generated to counter negative emotions, the seven basic states studied were happiness, sadness, anger, fright, surprised, disgust, and neutral. Majority of gathered tweets using Naïve Bayes Algorithm were neutral and gained 79% of the percentage and 18% for happy. With those remarks, the accuracy of the developed system is 70% effective. Nonetheless, the researchers suggested that other dialects can be incorporated to increase the effectiveness of the classifier [5].

Estimating Filipino ISPs Customer Satisfaction Using Sentiment Analysis

"Estimating Filipino ISPs Customer Satisfaction Using Sentiment Analysis" is a study conducted to assess customer satisfaction to ISPs in the Philippines. Using the sentiment analysis (SA) and natural language processing (NLP), together with text analytics Patacsil et. al think this as a way to extract useful information from textual data. As mention above, SA is one of the techniques that the researcher used. SA was used to estimate the satisfaction of the customer, while NLP uses the automatic word seeding in selecting the word dictionary, which has a pair set, the Good and Slow. To identify the polarity of each word and its dominance, the Naïve Bayes method was applied. The data used in this study were collected in blog posts. This proposed classifier successfully identified the positive and negative among those posts, the accuracy was 91.50% in the testing stage. However, the actual evaluation drops the accuracy rate into 60.27%. Here some factors include the posts labeled as Taglish, which makes the polarity of the word change. Special characters also affect the accuracy of the system, for example, is the "Mbps download speed bul @ # \$ % hit !" posted by the clients, which the system did not understand [6].

METHODOLOGY

In the development of the Bilingual Feedback Management System for Frontline Services with Sentiment Analysis using Naïve Bayes Algorithm, the incremental software development model was adopted as the system development methodology. This methodology delivers a series of releases, called increments, provide progressively more functionality for the customer as each increment is delivered. The first increment is often the core production, which the basic and most urgent functionalities are addressed. This allows the users to undergo a detailed evaluation of the system in the earliest stage. The result of the evaluation was used to develop a plan for the next increment. The plan addresses the modification needed for the core product to deliver additional features and functionality that the user missed from the current increment. This process was repeated until the product is completed and ready to produce.

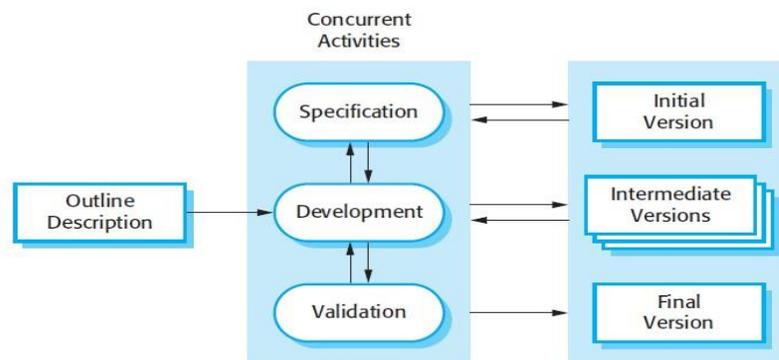


Figure 1. Incremental Development Model

Figure 1 shows the Incremental development model provided by Sommerville [7]. It shows that outline description is the beginning of the development process. In this process, the researcher provided an overview of the developed

system. When this is provided, the process can be the next step to the three concurrent activities, the specification, development, and validation.

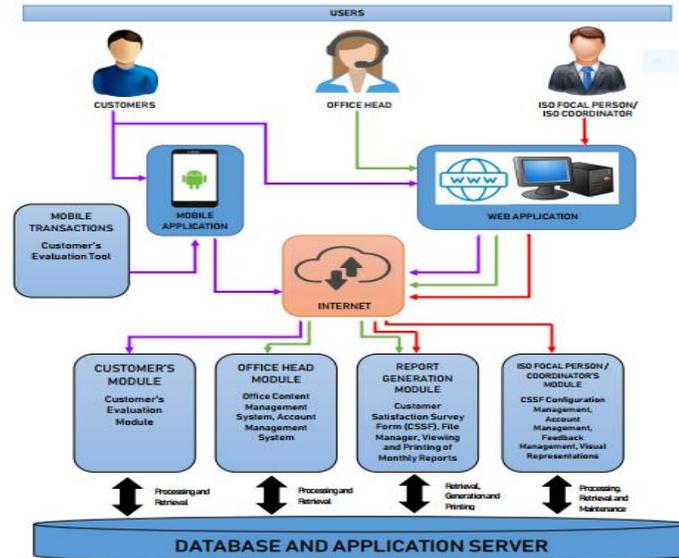


Figure 2. System Architecture of the Developed Feedback Management System

Figure 2 shows the system architecture of the developed feedback management system. It represents the structural perspective of the system.

The architecture is divided into layers: the users, users means of communicating to the web server, the web server, the modules, the processing and data retrieval and lastly, the database server and application server. The users' layer includes the persons or individual who has access to the system. The users' means of communicating to the web server includes the mobile application and web application. The web server layer includes the web server of the system. The modules layer includes business processes that the system can do. The processing and data retrieval layer include the processes on how each module communicates to the database and application server. And lastly, the database and application server layer wherein the database server of the system, as well as the application server, are included. The architecture also includes color-coded flow lines that represent each user and its level access rights on the system

Algorithm

In this study, the researcher used sentiment analysis. It is a type of algorithm that is used to determine the emotion or sentiment based on the inputs. It is sometimes called as opinion mining. There are many algorithms that are used in sentiment analysis, one of which is the Naïve-Bayes Algorithm.

Naïve-Bayes Algorithm is based on the so-called Bayesian theorem. Naïve-Bayes Classifier has been defined as this mathematical notation below which means the posterior probability of class given predictor is equal to the prior probability of a class multiplied by the probability of a predictor given class divided by the prior probability of the predictor.

$$P(\text{Sentiment} \setminus \text{Sentence}) = \sum_{n=1} P(c) (P_x|c) / P(x)$$

Based upon the above Naïve Bayes classifier function, the researcher presented an approach to optimize the Naive Bayes classification algorithm by removing the redundant correlated and irrelevant features so that algorithm can be applied/used with a significant improvement in the domain which involves correlated features. The researcher applied this type of algorithm to the study, specifically in determining the polarity of the customer's feedbacks or suggestions.

Respondents of the Study

The participants of the study included 108 respondents: 1 Quality Assurance Officer, 7 Office Heads and randomly selected customers composed of 60 students 15 parents, 10 guests, 5 employees, 5 faculty members and 5 alumni.

RESULTS

Table 1. Level of Impact of Problems Encountered by All Respondents

Respondent	Weighted Mean	Verbal Interpretation
Customers	2.66	Moderate Problem
ISO Staffs and Office Heads	2.25	Minor Problem
Overall Weighted Mean	2.46	Minor Problem

Table 1 shows that the customer respondents evaluated their problems as Moderate and ISO Staff and Office Heads respondents rated their problems as minor. Overall, the evaluation of all respondents to the problems that they have encountered was Minor. Most of the customers feel awkward writing in public. This can be attributed to the fact that they are not given areas to provide or write their feedbacks privately. While ISO Staffs and Offices Heads' top problem was the monitoring of the monthly performance of the offices. This is ascribed to time-inefficiency in gathering the feedbacks which also requires a lot of manpower to have the monitoring results.

Table 2. Technical Software Quality Assurance Evaluation Results

Module	Alpha Testing	Beta Testing	User Acceptance Testing
Customer	Passed	Passed	Passed
ISO Focal Person	Passed	Passed	Passed
Office Head	Passed	Passed	Passed
Report Generation	Passed	Passed	Passed

Table 2 shows that customer's module, ISO Focal Person's module, Office Head's module, and Report Generation module have passed the alpha, beta, and user acceptance testing. Overall, all system modules have passed the technical software quality assurance test. This indicates that the developed application is confirmed fully functional.

Table 3. Level of Agreement of the ISO Focal Person/Coordinator and Office Heads to the Effectiveness of the Developed System

Features	Weighted Mean	Verbal Interpretation
Feedback Collection	4.63	Strongly Agree
Feedback Analysis	4.21	Strongly Agree
Report Generation	4.50	Strongly Agree
Customer's Information Privacy	4.25	Strongly Agree
Overall Weighted Mean	4.40	Strongly Agree

Table 3 shows that the respondents rated 4.63 in all criteria of feedback collection, 4.21 in all aspects of feedback analysis, 4.50 in the report generation and 4.25 on the things relative to customer's information privacy. Overall, the respondents evaluated the effectiveness of the developed system was 4.40 with a verbal interpretation of 'Strongly Agree'. This data means that features of the system was engineered carefully and satisfied all the requirements set on the specifications document.

Table 4. Evaluation of the Customer Respondents Relative to the Developed Mobile and Web Application

System Feature	Weighted Mean	Verbal Interpretation
Ease of Use	4.61	Highly Acceptable
Portability	4.50	Highly Acceptable
Functionality	4.56	Highly Acceptable
Overall Weighted Mean	4.56	Highly Acceptable

Table 4 shows that the respondents rated 4.61 in all aspects of ease of use, 4.50 in all criteria of the system's portability and 4.56 on its functionality. Overall, the respondents rated 4.56 with a verbal interpretation of 'Highly Acceptable' as their evaluation of the developed mobile and web application. This data means that the system features of mobile and web applications were confirmed useful, portable and fully functional

DISCUSSION

Overall, all system modules have passed the technical software quality assurance test. Likewise, the majority of the respondents have a high level of agreement in the developed system which is congruent to and as also evidenced by positive results in different tests. In addition, respondents have high acceptance with regard to developed mobile and web applications.

CONCLUSIONS AND RECOMMENDATIONS

In accordance with the findings of the study, the existing system produces minor to moderate problems. Likewise, the said problems were resolved by the developed system as it was proven to be effective in terms of feedback collection, feedback analysis, report generation, and customer's information privacy. Full deployment of the web and mobile applications among customers is suggested as a more usable, portable, functional and secured mechanism for providing feedbacks among frontline service offices of the university.

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