International Journal of Engineering & Technology, 8 (1.7) (2019) 227-233

International Journal of Engineering & Technology

Website: www.sciencepubco.com/index.php/IJET

Research paper



An Emotional Agent Approach for Online Customer Satisfaction Surveys Analysis

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Abstract

A modern approach for ensuring quality in organizations and enterprises, as well as enhancing the development of a truly customer-focused management and culture, is through the Customer Satisfaction Survey (CSS). In this paper, an Emotional Agent (EA) possessing the BDI architecture for CSS is proposed. The EA is integrated into an Online Customer Satisfaction Surveys Analysis (OCSSA) System. The EA is used in analyzing the satisfaction of customer and express an emotion representation to the results via the graphical user interface. The emotional results are categorized into five emotional levels: Very Happy, Happy, Neutral, Sad and Very Sad; these cases are expressed through emoji icons. The implementation of the OCSSA is done through the use of object-oriented methodology. The system's implementation includes Jade and Java agent platform. The testing of the OCSSA system has been carried out in Kentucky Fried Chicken (KFC) and Pizza Hut (PH) case studies. The test is specifically conducted in order to evaluate the satisfaction rate of customers that visit PH and KFC. The use of emotional agents is employed in analyzing the CSS. The system successfully performs 10 tests for each of the tested cases. Through the use of this system, the manager is able to obtain feedback about the services provided in a visualized and informative way.

Keywords: *Customer Satisfaction Survey (CSS), Software Agent, Emotional Agent (EA), Kentucky Fried Chicken (KFC) and Pizza Hut (PH).*

1. Introduction

Customer Satisfaction Survey (CSS) is a modern approach which is used to ensure the delivery of quality service in organizations and enterprises. It also enhances the development of a culture and management that is genuinely customer-oriented. Research in the area of CSS is one of the rapidly growing segments of the marketing field [1]. In recent times, the attention of researchers in the management and marketing sciences has been drawn to the coordination of all the organizations' activities so as to make provision for goods and services that can meet the specific needs of potential and existing customers. Many companies have chosen customer satisfaction as their key performance indicator to enable them to reinforce customer orientation on a daily basis. However, keeping a company permanently motivated by the notion of customer satisfaction is almost impossible [2]. Thus, it is important to translate customer satisfaction into a number of parameters that measurable and directly connected to people's job. In other words, customer satisfaction must be translated into factors that people can understand and influence [3].

One of the most efficient ways of finding out if customers are satisfied is by asking them. The direction and content of the questionnaire used in asking for this feedback are crucial to identifying and analysing the pros and cons of performances and products. More so, in order to reduce bias and obtain honest responses, the time and manner in which the questions are asked are also crucial factors that must be considered. Most importantly, the analysis of the responses must be performed carefully, and the outcomes must be processed [4].

Globally, analysing CSS have become a growing concern for business organizations. One of the key principles of the management science is the concept of "you cannot manage what you cannot measure"[2]. It is possible to gain knowledge on the performance of the business and customer loyalty (willingness to recommend or repurchase) through the use of the CSS [5]. Automated CSS analysis can be carried using any of the different statistical, probabilistic, computational and comparative methods. Some examples are Texel statistical program [2], neural network [6], and software agent [7], [8].

One of the artificial intelligence techniques is an emotional agent, which plays a significant role in enhancing cognitive activities that include rational thinking, decision-making and learning [9]. Thus, in this paper, the emotional agent is combined with a CSS analysis approach in order to evaluate and analyse user satisfaction rate. KFC and PH are used in this system as the domains.

In this section, the initial picture of the work which uses an emotional agent in CSS analysis is presented. The agent gives a response to the feedback provided by customers about the ser-vices which are provided. In Section 2, the methods and materials which include data collection and description of the procedure, CSS, CSS analysis, software agent and emotion agent. In Section 3 explanations of the OCSSA system is given; the explanation covers the architecture of the emotional agent and the CSS structure. Section 4 presents the implementation and results. Finally, in Section 5 the conclusion and future work are presented.

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2. Methods and Materials

2.1. Customer Satisfaction Survey

Customer Satisfaction (CS) which is used in measuring how services and products provided by a company satisfy or surpass the expectation of the customer, is a term that is commonly used in the field of marketing. CS is defined as "the number of customers or percentage of total customers, whose reported experience with a firm, its products, or its services exceeds specified satisfaction goals" [10]. Customer requirement is the drive for quality. Customer survey data are crucial to the quantitative management of customer satisfaction. In other words, customer survey data are one of the major ways through which customer satisfaction can be quantitatively managed. This special issue of Quality Technology and Quantitative Management (QTQM) paves way for new applications of statistical methods to customer satisfaction survey data analysis [11]. Customer Satisfaction Surveys (CSS) are considered important tools which enable the discovery of clients' satisfaction with the products or services of a company by businesses.
The CSS includes a number of questionnaires for a domain of study. The targeted people are taken into consideration when the questionnaire is being designed, the objects under study are sampled [12].

2.2. Data Collection and Description

Data can be collected from customers about the product, company or services received through several methods [1-4]. The different methods are briefly described as follows:

1. Registration: A register is a depository containing in-formation about companies, humans etc. Through a legal requirement, the register can be used in obtaining complete enumeration.
2. Questionnaires: questionnaires are different from interviews whereby questions are directly posed by the enumerator; they are different in the sense that the respondents are only required to complete forms containing questions. Questionnaires can be self-administered face-to-face or sent by email and later sent through a stamped addressed envelope.
3. Interviews: here, enumerators obtain information through inquiry which is recorded. The use of survey forms is employed in structured interviews, where notes are taken while the respondents are talking in open inter-views.
4. Survey: a sampling, or partial collection, of facts, figures, or opinions taken and used to approximate or indicate what a complete collection and analysis might reveal.
5. Phone: information can be obtained from respondents through a phone call, which involves using their phone numbers to call them and seek their permission to participate in the survey you are conducting. For in-stance, customer service providers can ask customers can call customers and ask them to rate their companies, products or services.
6. Email: this method can also be used without the customers being physically present in the company. This simply means that the customers can respond through the use of their phones, and this does not consume much time. This method of data collection has been used for ages, and it is possible to predict the results.
7. Application: this is an interactive way of asking customers for feedback about a company's goods or ser-vices. Some people prefer to participate in surveys through applications.

2.3. The Analysis of CSS

Customer satisfaction is a representation of the customers' opinion about the quality of service or product. The satisfaction is a continuous variable that its rating ranges from not satisfied to completely satisfied [3], [9]. Customer satisfaction analysis has become an area of great concern to business organizations in the world. Thus, it is important to measure the satisfaction of customers. The importance given to measurement in the world of marketing is one of the reasons why one of its major principles is the concept of you cannot manage what you cannot measure; one of the five main functions of a manager is measurement [7], [11]. Indeed, the idea of measurement is crucial to the scientific method, and it is arguably the foundation of human knowledge. There are two major divisions of methods of analysing CSS data, and they are briefly described as follows:

- Statistic Methods: these methods are vital in managing service quality. It is important for service providers to the level of their service quality and to have knowledge about the service(s) attributes that add value and increase customer satisfaction. It is also important for them to know which of the service attributes only satisfies minimum requirements and reduces dissatisfaction, and which achieves both [8].
- Computational Methods: these methods basically use techniques of Artificial Intelligence. These methods are used based on the variance of the initial sample [9].

2.3. Software Agent

A software-agent system is described as a set of intelligent agents that interact with each other in an environment [13], [14]. The problem that cannot be independently solved is jointly solved by these agents [15], [16]. There are so many features possessed by agents, and they include autonomy, adaptation, responsiveness, scalability, distribution and local view [17]. Interaction must occur between the agents so that a certain goal can be achieved [18].
Various application domains are possessed by the multi-agent systems, and some of them include autonomous UAV system [18], social studies [19], data mining [16], health care [15], ambient systems [20] and expert systems [21]. These agents are specifically used in the abovementioned systems to improve: (1) the efficiency and speed performance (2) the scalability and flexibility of the operations, and (3) the system modules reusability [22]. Different kinds of software agents such as adjustable autonomy, commitment, emotional deliberation etc. exist [17]. However, the focus of this paper is on the emotional agent because it is part of the proposed system.

2.4. Emotional Agent

A number of disciplines are covered by emotion research, and these disciplines include behavioural sciences, artificial intelligence, phenomenology, philosophy, cognitive science and physiology. Emotion research in artificial intelligence plays a vital role, as it supports

cognitive activities like rational-thinking, learning and decision-making [23]. The attention given to emotion research is due to its potentials. It should receive better attention due to its potentials to provide credible characters and creative solutions [24]. However, no obvious advancements have been observed in the outcomes of emotion research in the field of artificial intelligence. In recent time emotion has been initiated in software agent research and applications like [25] and [26]. The autonomy of agent, social interactions and adoption can be enhanced by integrating emotion in software agents [17].

For instance, when a human assistant agent knows that the human is upset, the agent will decide to avoid interaction with the human. Great efforts geared at developing emotional software agents for robotic applications have been made [26]. Other efforts include toys, games, e-commerce, domestic and medical applications with the objective to support and facilitate the daily routines of humans. However, the major problem is that emotional behaviour is almost absent in the majority of popular agent models [27].

In order to model emotions in an agent, its drivers and BDI must identify [22]. More so, the agent must be equipped with mechanisms which it can use in expressing its emotions as well as in capturing the emotions of others. Through the use of the emotional model, the agent is able to internally manage its emotions by changing its mental attitudes, or externally by decoding them into actions [25]. The emotional condition of an agent which is equipped with emotions can affect its decisions to a certain instinct. For example, the commitment of a civilian agent to pursue its goals is more affected than that of a soldier when the agent encounters threats that place its emotional state at risk [22]. Therefore, both will respond to the threat in different manners based on how stressed their emotional states are. In multi-agent systems, it is found that emotion in agents can be directed to manage an individual and team goals [27].

3. The OCSSA System Design

In this section, the Online Customer Satisfaction Surveys Analysis (OCSSA) System and the EA architecture is presented. The OCSSA is basically made up of four modules, which are interaction, analysis, survey and reporting. An emotional agent is deployed in the OCSSA to carry out the analysis. The agent runs in three phases, which are input, analysis and output phases. In the input phase, the feedback of customers about a certain service or product of a CSS is observed. In the analysis phase, linear measurements for all the items of the survey segment are implemented individually, followed by a linear regression aimed at producing the overall analysis. At the output phase, detailed results of emotions are produced. Fig. 1 shows the OCSSA system. The OCSSA system alongside its application scenario is described in the following subsections.

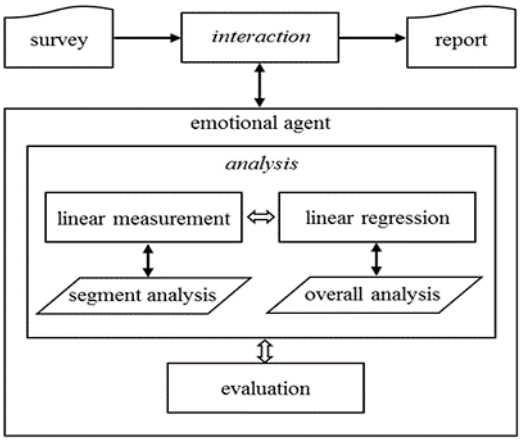


Fig. 1: The OCSSA system design

3.1. Modelling the CSS Analysis Approach

The CSS is often made up of a series of questioners of a domain, $\boldsymbol{Q^d}$. The $\boldsymbol{Q^d}$ are linguistic expressions for a serve of the domain through which the user's opinions for a specific deliverable or serves are investigated. The $\boldsymbol{Q^d}$ are distributed to cover several segments, $\boldsymbol{S^d}$ in which the $\boldsymbol{S^d} \subset \boldsymbol{Q^d}$. The evaluation of customer satisfaction condition, $\boldsymbol{C^d}$, is performed based on a limited number of levels or scales, $\boldsymbol{L^d}$, in which $\boldsymbol{L^d} = \{\boldsymbol{l_1}, \boldsymbol{l_2}, \ldots \boldsymbol{l_K}\}$ and each of which indicates the $\boldsymbol{C^d}$ evaluation. The structure of CSS is shown in Fig. 2.

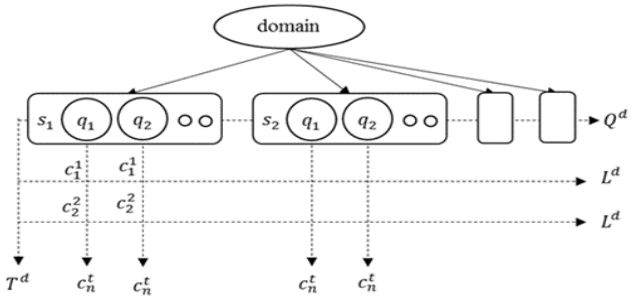


Fig. 2: The structure of the CSS

The C^d changes dynamically based on the L^d, L^d X $C^d \rightarrow C^d$. Each of the c is linked by two covariates which are, customer number, N^d and time, T^d in which an $n \in N^d$; $i = \{1, 2, \ldots, n\}$; $t \in T^d$; and c_n^t. The following format represents the overall data:

$$s_1^d\Big((q_1,(c_1^1,c_2^2,\dots)),(q_2,(c_1^1,c_2^2,\dots)),\dots\Big),s_2^d(\dots),\dots \tag{1}$$

The data format in (2) models the $\boldsymbol{C^d}$ data with longitudinal techniques to structure and visualize the CSS lifecycle.

3.2. Modelling the Emotional Agent

A BDI architecture in which the emotional state of the agent is influenced by the changes in its beliefs, *B*, and desires, *D* [19], [22] is possessed by the emotional agent. The goal of the agent is to make provision for an analysis which enables the improvement of the customer satisfaction. It is through the interaction of the agent with the human during when the survey is being inserted, that the agent is able to interpret the world (mainly in the EA-CSS). This interaction leads to changes in its *B* and *D*. An emotion is stimulated, or the emotional state of the agent is changed by the unification of the emotional beliefs, B^e , and desires, D^e . The responses of the agent to the customers' inputs are denoted by intentions, *I*. Such responses include reports and expressions. The architecture of the emotional agent is shown in Fig. 3.

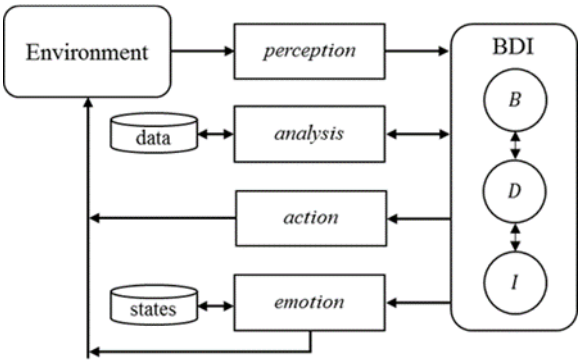


Fig. 3: The emotional agent architecture

There is an association between the emotions of the agent and the customers' emotions. Its motivation is represented by making the customer highly satisfied.

4. Implementation and Results

In order to test and evaluate the Online Customer Satisfaction Surveys Analysis (OCSSA) system, it is used in two KFC branches and PH located in Johor, Malaysia. The implementation of the system includes Jade and Java agent platform. In that of KFC, 9 questions and their corresponding answer options are given, while that of PH contained 7 question and their answer options. The survey contained questions related to the food taste and price of KFC. A five Likert scale is provided for both KFC and PH. The question describes the serves provides by KFC including a taste of food, and the price. The survey forms for KFC and PH are contained in Fig. 4 and Fig. 5 respectively.

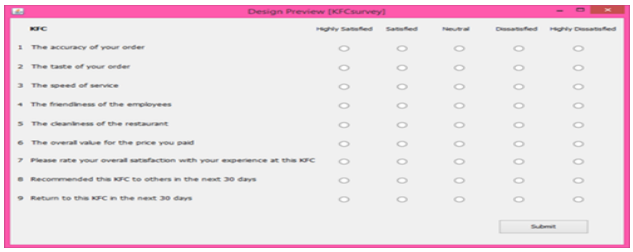


Fig. 4: The survey form KFC

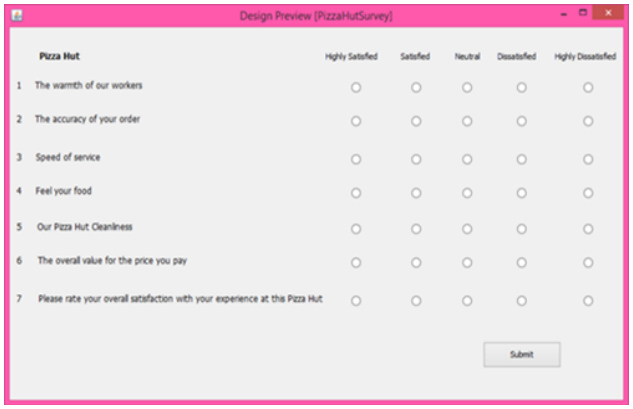


Fig. 5: The survey form Pizza Hut

Five emotional states are used in evaluating the user level of satisfaction: Very Happy, Happy, Neutral, Sad and Very Sad. The responses of the customers alongside the emotional state of the agents are mapped in Table 1. Afterwards, the incoming inputs of the customers are processed dynamically by the agent. The quality of service is represented by the emotional expression of the agents. The problems of the service are detailed in the reports to propose solutions.

Table 1: The eliciting parameters of the emotional conditions

Level	Response	Emotion	Range (%)	Emoji
1	Very Unsatisfied	very sad	0-20	
2	Moderately Unsatisfied	sad	21-40	
3	Neutral	normal	41-60	
4	Moderately Satisfied	happy	61-80	
5	Very Satisfied	very happy	81-100	

The testing of the OCSSA system has been performed in KFC and PH as two case studies. The aim of the test is to evaluate the rate of satisfaction of customers that visit PH and KFC through the use of the emotional agent in analysing their CSS. The system successfully performs 10 tests for each of the tested cases. The accumulative responses of the customers to the system determines the final result. Based on the results of the OCSSA the customers are moderately satisfied with both of the KFC and PH. In Fig. 6, the final results of the data collected from KFC is presented.

The samples of responses and results obtained from KFC customers are presented in Table 2. The sample consists of 9 questions with the analysis of 10 tests (a_1, a_2, ...). The emotional state of an agent for KFC domain is measured based on the result. The Emoji presentation is used in expressing the final emotional condition.



Fig. 6: The CSS analysis of the KFC

Table 2: The KFC Results

a_1	a_2	a_3	a_4	a_5	a_6	a_7	a_8	a_9	a_{10}	%	Emoji
4	3	2	4	2	3	5	4	4	4	70	
3	3	4	2	2	5	4	2	4	2	72	
2	3	4	2	2	5	5	4	4	5	62	
5	4	2	4	2	2	2	5	4	4	72	
2	3	5	3	4	2	3	3	5	2	68	
3	3	3	5	2	5	5	3	2	2	64	
4	5	3	4	4	5	2	2	3	5	66	
4	5	3	4	4	5	2	2	3	5	74	
2	2	2	5	5	5	2	3	4	5	70	

Table 3 shows samples of the answers and results that are collected from the PH customers. The sample consists of 7 questions with the analysis of 10 tests (a1, 2, ...). These results are used in measuring the emotional state of the agent in PH.

Table 3: The PH Results

a_1	a_2	a_3	a_4	a_5	a_6	a_7	a_8	a_9	a_{10}	%	Emoji
2	2	4	2	2	2	3	3	3	4	54	
4	3	5	2	4	3	2	4	3	5	70	
4	3	3	4	3	4	2	2	4	3	64	
3	4	2	3	4	2	4	5	5	5	74	
5	2	3	3	3	3	2	2	3	2	56	
3	2	2	3	4	2	4	5	2	4	62	
2	2	5	3	4	4	3	3	2	2	60	

The system helps the manager to find the weak point in overall services and propose solutions. Fig. 7 depicts the difference between KFC and PH customers' satisfaction rates based on the OCSSA analysis.

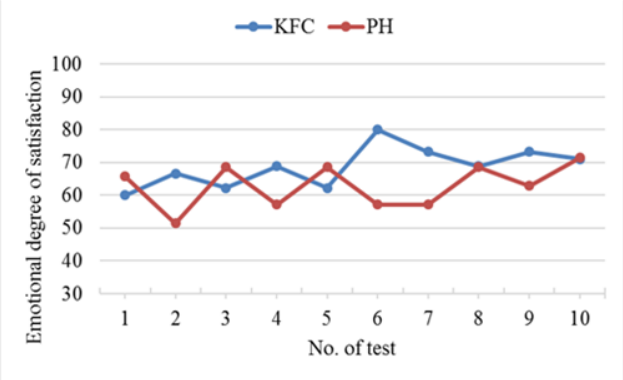


Fig. 7: The agent's emotional analysis of the KFC and PH CSSs

5. Conclusion and Future Work

For a business to be improved, it must put into consideration the needs and concerns of the customers. Therefore, feedback must be collected from customers, and the best way to gather these feedbacks is through the implementation of a CSS which involves the collection of information through customer surveys and forums, as well as through the interactions that take place during normal transactions. In this paper, an Online Customer Satisfaction Surveys Analysis (OCSSA) system is proposed. In the OCSSA system, an emotional agent which analyses the CSSs is included. The feedback of the customer about a certain service and product of the CSSs is observed by the emotional agent. Accordingly, the level of customer satisfaction is measured and aggregated into emotional expression. Customers, managers and stakeholders can view this approach of analysis online for further actions. The implementation of the OCSSA system in a web-based commercial system forms the future work.

Acknowledgement

This project is partially sponsored by the Tier 1 research grant scheme of Universiti Tun Hussein Onn Malaysia under Vot U893.

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