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A fuzzy logic-based system for assessing the level of business-to-consumer (B2C) trust in electronic commerce

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Abstract

The purpose of this paper is to present an application of fuzzy logic to human reasoning about electronic commerce (e-commerce) transactions. This paper uncovers some of the hidden relationships between critical factors such as security, familiarity, design, and competitiveness. We analyze the effect of these factors on human decision process and how they affect the Business-to-Consumer (B2C) outcome when they are used collectively. This research provides a toolset for B2C vendors to access and evaluate a user's transaction decision process, and also an assisted reasoning tool for the online user.

Keywords: Business-to-Consumer; e-commerce; Fuzzy logic

1. Introduction and motivation

During online shopping, a user often relies on common sense and applies vague and ambiguous terms when making a buying decision. Online customer normally develops in his/her mind some sort of ambiguity, given the choice of similar alternative products and services (Mohanty & Bhasker, 2005). Decisions to buy or not to buy online are often based on users' human intuitions common sense and experience, rather than on the availability of clear, concise and accurate data. Fuzzy logic is used for reasoning about inherently vague concepts (Lukasiewicz, 1970), such as 'online shopping is convenient', where level of convenience is open to interpretation. The purpose of this research is therefore to apply the fuzzy logic to human reasoning where we specifically focus on the reasoning processes behind e-commerce transactions.

Fuzzy systems allow the encoding of knowledge in a form that can be used to reflect the way humans think about a complex problem such as online shopping. A human usually think in imprecise terms such as *high* and *low*, *fast* and *slow*, and *heavy* and *light* (Black, 1937). Fuzzy expert system model imprecise information, by attempting to capture knowledge in a similar fashion to the way in which it is considered to be represented in the human mind, and therefore improves cognitive modelling of a problem (Cox, 1994). As a result, fuzzy logic is leading to new and human-like, intelligent systems that might be used to understand the thought processes behind any B2C transactions. The rationale for using fuzzy logic systems to uncover vague decision process because it is well suited for modeling human decision-making. Human decision-making is complex, and can be based on simultaneous evaluation of many facets such as fear, experience, privacy, intuition and so forth.

Though many factors influence the decision process of B2C transactions such as ease-of-use, pricing, convenience, and security (Akhter et al., 2003), the perception of an influencing feature is more important than the actual level of the feature itself. For example if the perceived security level is higher than its actual implementation then that will contribute positively to the level of B2C outcome. There may be cases where the reverse is true as well, but for such cases a high level of persuasion will be needed to alter the perception level. This research had adopted a fuzzy logic approach and utilized a mathematical research toolset

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known as Matlab fuzzy logic toolbox® to provide a means of coping with the ambiguity and vagueness that are often present in determining a transaction level in e-commerce.

To build a fuzzy expert system for B2C e-commerce that is based on fuzzy logic, this research has captured, organised and used human expert knowledge (acquired by surveys and interviews). This research proposed to organise knowledge in terms of its logical groupings such as security, familiarity, design layout, competitiveness and trust.

This paper is organized as follows. Section 2 discusses research methodology that demonstrates the value of qualitative technique for inquiry and analysis of data. Data collection and analysis explained in Section 3. Section 4 covered the rules providing a measure for Trust and B2C levels. Section 5 explained the analysis of different factors influencing Trust. Section 6 visualizes the Trust level and Section 7 draws our conclusions.

2. Methodology

This research is based on the rationale that actual level of any B2C transaction is based on two factors, namely: what is the level of Trust (T) of the given website, and how competitive (C) is this site for purchasing purposes? Therefore, we propose to investigate into the truthfulness of the following relationships:

$$T = f(S, F, D) \tag{1}$$

$$L_{\mathrm{B2C}} = g(T, C) \tag{2}$$

Where S is the level of *security*, F is the level of *familiarity*, and D is the level of *design layout* of the B2C site. The premise is that the factors determining the level of *Trust* T are a function of these three parameters. Therefore any degree of B2C transaction will be based of the level of *Trust* (T) and the *competitiveness* (C) of the website. In order to analyse the impact of human decisions on the level of e-commerce transactions, it was organise and categorise the factors that are significant to the decision processes linked to conducting the B2C transaction.

It is apparent from Fig. 1 that a given level of Trust may lead to a membership of more than one fuzzy set. This membership is represented by its degree or intensity. Therefore, as a consequence this may lead to the partial execution of the antecedent (one or more premises) and subsequent partial execution of the consequent of the fuzzy rules. The total numbers of rules depend on the number of hedges for each fuzzy set. Trust will have five fuzzy subsets, each of which are given by their membership function as depicted in Fig. 1. Similarly the security, familiarity and design can be divided into three levels (low, moderate and high). Hence the number of fuzzy rules for determining the level of trust can be derived as: security (three), familiarity (three) and design layout (three), which combined results in 27 distinct fuzzy rules.

In order to get a complete picture of fuzzy expert system, an inference diagram can give a detailed explanation of the processes involved. The picture in Fig. 2 attempts to summarise the steps and processes involved. As can be seen, the process with the crisp inputs to the fuzzy expert system; for example, this might be the crisp input for security, and familiarity or design to get a value for the trust level.

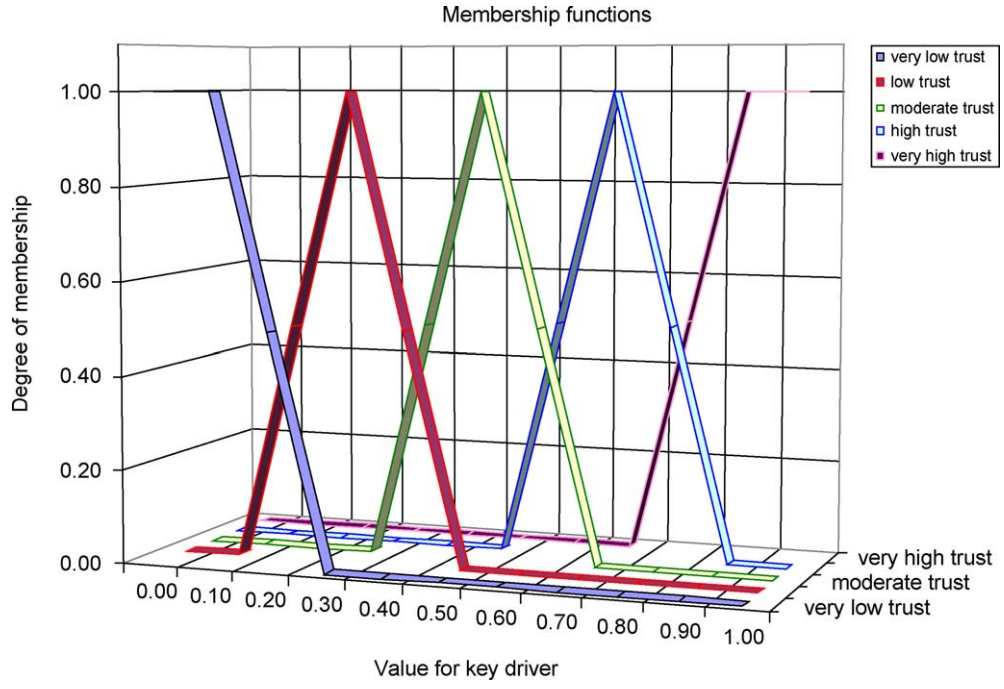

Fig. 1. Displays the membership functions for different fuzzy sets belonging to trust.