Client Satisfaction Diagnosis
A Knowledge Based Approach

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Abstract. Many are the solutions being used nowadays by retail companies to ensure that their clients remain satisfied and confident in their services, minimizing the risk of them moving on to the competition.

These solutions range from Customer Relationship Management (CRM) software to Machine Learning-based systems that enable marketing and customer retention departments to better analyze and predict which clients may be dissatisfied with the company's services.

Although less common, Knowledge Based Systems show up as valuable alternative, offering richer explanations and more flexibility in its implementation when compared to the aforementioned solutions.

The solution proposed by the team in this article falls in the latter category, comprising of an Expert System not only capable of predicting dissatisfied clients, but also identifying their dissatisfaction reasons and coming up with an action plan that may build their confidence back in the company's services, minimizing the risk of their departure.

Keywords: Retail · E-Commerce · Clients · Satisfaction · Loyalty · Churn · Artificial Intelligence · Expert System · Knowledge.

1 Introduction

1.1 Context

This article was written within the scope of the Master's Degree in Artificial Intelligence Engineering (MEIA) at ISEP and its course unit Programming Paradigms in Artificial Intelligence (PPROGIA).

It contains a state of the art analysis of Client Satisfaction Diagnosis, the main theme of the first challenge for team 2: Smart Retail, as well as a brief overview of the team's proposed solution.

1.2 Motivation

The team believes that, in retail, the client must be the centre of focus of the business, with companies guaranteeing their satisfaction and confidence in the services they offer on a daily basis.

A key indicator of client satisfaction is the company's churn rate, which specifies the rate of clients leaving the company for its competition [1].

Studies in the American market show that, in a period of 5 years, companies tend to lose 50% of their clients for the competition [2]. As such, it's on the company's best interest to keep the churn rate low, by applying strategies and solutions that may allow the detection of dissatisfied clients before they depart.

Nowadays, these solutions range from Customer Relationship Management (CRM) software to Machine Learning (ML) solutions, with the former providing marketing and client retention departments with a good overview of the clients' activity with the company, while the latter provides accurate churn predictions based on the available client data.

Although less common, there are also Knowledge Based Systems (KBS), such as Expert Systems, capable of providing the same predictions performed by ML models, while providing rich and detailed explanations, something that ML models are currently lacking, making it a worthy alternative for companies to use, as it allows marketing and client retention teams to understand why a client may be dissatisfied and thus make more informed and secure decisions.

1.3 Research Method

Regarding the research method, the team had the opportunity to discuss it with the course unit's head professor Constantino Martins in one of his classes, where he suggested the usage of tools such as Google Scholar and Science Direct to find the necessary scientific articles.

Furthermore, the team followed professor Constantino's advice to identify the main authors and the "original" articles in the covered fields, in order to reach the most relevant and credible sources of information.

1.4 Article Structure

This article is divided into two main parts: the state of the art of Customer Satisfaction Diagnosis solutions, all the way from CRM software to ML and Knowledge Based Systems, followed by a brief presentation of the solution proposed by the team, including an overview of its main features, as well as its benefits and current limitations.

In the conclusion, a few thoughts will be shared by the team about the proposed solution and how future work done by the scientific community may allow the solution to reach its maximum potential.

2 State of the Art

2.1 Overview

As stated before, many are the solutions currently being used by companies to diagnose their clients' satisfaction and confidence in their services.

In this chapter, the usage of CRM software, ML models and Knowledge Based Systems to diagnose client satisfaction will be analysed, with particular emphasis in the latter, as it follows the solution proposed in chapter 3 more closely.

2.2 Client Relationship Management (CRM) Software

Throughout the years, the relationship between buyers and sellers as been the primary focus for marketing departments in retail companies around the world.

Unfortunately, many of the older strategies and solutions used by companies treated exchanges between buyer-seller as discrete events and not as it should be: an ongoing and continuous relationship [3].

As such, in order to treat each client with the attention they deserve, Client Relationship Management (CRM) services, such as SalesForce [4], ZenDesk [5] and HubSpot [6], are currently being adopted by companies worldwide.

These types of systems contain different sets of tools commonly presented through a dashboard and used by marketing and client retention departments to analyse, track and maintain a client's trust and satisfaction in the company's services, based on their activity and other collected data [7].

In the article "Customer retention through customer relationship management: The exploration of two-way communication and conflict handling", M.Roberts-Lombard encourages the use of CRM software by companies as a means to retain their current clients, acquire new ones and maximize their lifetime value [8].

2.3 Machine Learning Based Systems

When it comes to churn prediction, machine learning models are some of the most common solutions out there, with various ML techniques being actively studied and applied, such as: Hybrid Neural Networks [9], Balanced Random Forests [10] and more traditional algorithms, ranging from Support Vector Machines and to Logistic Regression and Decision Trees [1].

ML-based solutions are usually very effective and generalize well when predicting dissatisfied clients, but are rather restrictive in their implementation, as they require a large and representative dataset to be trained, which may be difficult to obtain, and they are difficult to adapt after being trained.

Furthermore, techniques such as neural networks are known for their black-box characteristics, being rather difficult to understand the rationale behind the predictions provided by the model, which may lead to a certain distrust from the people responsible for decision-making at the companies.

2.4 Knowledge Based Systems

In the article "A Prudent Based Approach for Customer Churn Prediction" [11], written by A. Amin, F. Rahim, M. Ramzan and S.Anwar, a Knowledge Based System is proposed for churn detection in the telecommunications market.

The results show that although this approach isn't as common for churn detection, it definitely has its own strengths and may be a valuable alternative for retail companies out there, as long as they have the necessary sources of knowledge (e.g. experts, datasets) to support the implementation of such a solution.

It is worth noting that, contrary to the approach followed in the solution proposed in chapter 3, the knowledge applied in this solution was obtained through the Ripple Down Rules (RDR) technique, first introduced in 1990 by Compton and Jansen [12], with the main objective of extracting and maintaining rules found in a given dataset, based on exploratory data analysis [11].

3 Proposed Solution

3.1 Overview

Despite the effectiveness of the most common solutions adopted by companies nowadays, they lack the capacity to explain their thought process and are usually way too restrictive in their implementations, making it difficult for companies to adapt them to their reality and business model.

As an alternative, the team proposes the development of a 2-phased Expert System, displayed on figure 1, that is not only capable of predicting dissatisfied clients, in a first stage, based on metrics associated with their interaction with the platform (e.g. checkout conversion rate, time spent searching for products), but is also capable of identifying their dissatisfaction reasons and coming up with an action plan that fits their needs and may build their confidence back in the company's services, in a second stage (e.g. by offering vouchers or sending them communications), minimizing the risk of their departure.

The following aspects are worth noting about this approach:

- **Experts** - before even considering adopting this solution, companies must verify if they have access to experts in the field of data analytical and client relations, as their knowledge is crucial to implement an expert system capable of performing as well or even better than them and currently existing solutions.
- **Uncertainty** - predictions of this nature are always uncertain, thus techniques such as the Bayes Theorem or Certainty Factors should be considered when designing the expert system. While developing this solution, the team verified that Certainty Factors are the easiest technique to implement and analyse with the experts, resulting in rules such as: "If a given client has a low checkout conversion rate, then he is dissatisfied with a certainty factor of 0.7 (with C.F. $\in [-1, 1]$)".

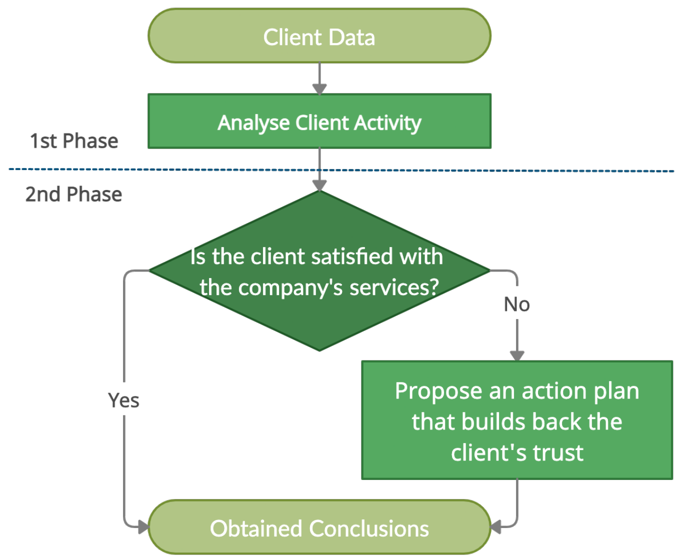

Fig. 1. Overview of the Expert System

As a means to demonstrate the suitability of this expert system to a real use case, the team decided to develop a web application, with the architecture shown in Figure 2, comprising of a single page application, the described expert system, in addition to a data management module, which enables the dynamic loading of client data to the various modules that make up the application, similar to how the solutions adopted by companies work.

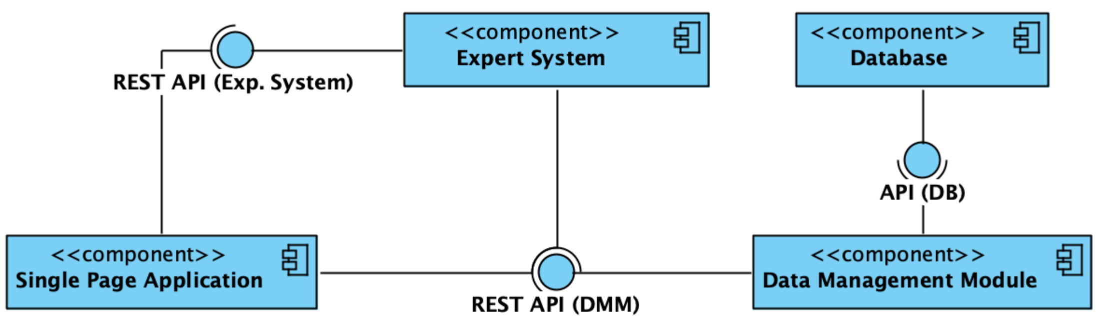

Fig. 2. Web application architecture

A small glimpse of the web application can be seen in figures 3 and 4: the application's main dashboard and client overview page, respectively.

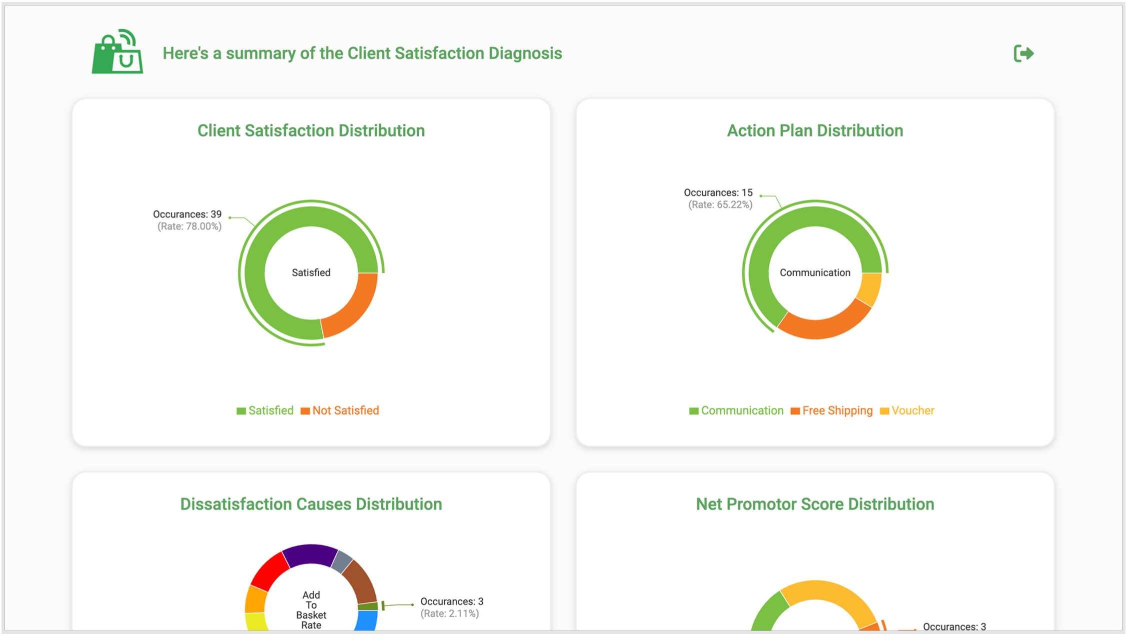

Fig. 3. Web application - Main dashboard

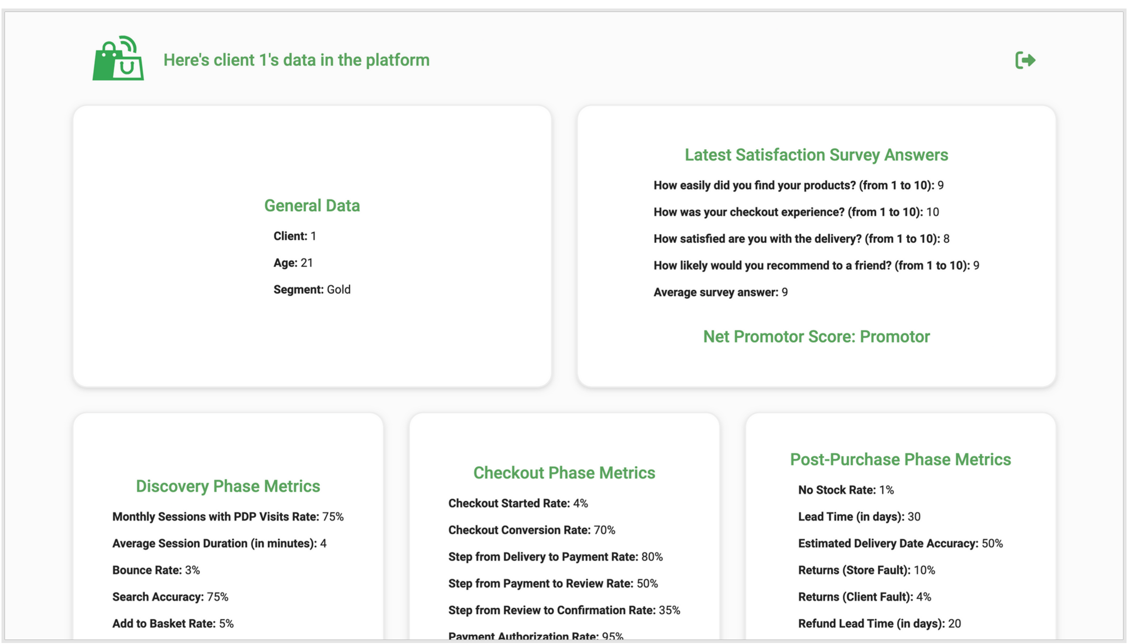

Fig. 4. Web application - Client overview page

3.2 Benefits

When compared to existing solutions, namely ML-based systems, this solution offers the following benefits:

- **Richer explanations:** the expert system offers rich and detailed explanations for questions that users may have, such as: (i) Why is client X dissatisfied?, (ii) Why isn't client X dissatisfied with the frequent product returns?, allowing them to make more informed and secure decisions. In the team's understanding, this may be the biggest benefit when compared to other existing solutions.
- **Personalized action plans:** given that the expert system is able to identify the dissatisfaction causes for each client, it is also able to come up with personalized action plans that are adjusted to the client's needs and dissatisfaction causes, maximizing the chances of his retention.
- **Ease of adaptation:** unlike ML models, which are trained for a given set of features, expert systems are rule based, which allows for an easier configuration and adaptation to the different realities and business models that each company may have.

3.3 Limitations

Having been designed and developed in such a short time span, the team readily identified limitations in the proposed solution, requiring some future work to reach its full potential, although it already presents a performance similar to that of the experts.

On the one hand, being one of the main benefits of this solution, explanations should be continuously improved, in order to reach a more natural, richer and more understandable speech for anyone with minimal knowledge of the domain.

On the other hand, when thinking of a more globalized solution, the team believes that the gathering of other types of metrics, such as the client's country or region, may allow the expert system to respond to more complex scenarios.

For the aforementioned example, the expert system would be able to adapt the values associated with the certainty factors depending on the country or region of a given client (e.g. clients from a given country may be more willing to ignore certain problems than clients from other countries), which would greatly improve the performance of the solution for international retail companies.

4 Conclusion

All in all, the team reiterates its belief that client satisfaction must always be the centre of focus of retail companies, with solutions such as CRM software, ML models and Knowledge Based Systems helping them assure that the rate of clients leaving for the competition remains as low as possible.

Furthermore, the team believes that, in hindsight, the proposed solution is not only relevant and valuable as it is, but also shows great potential to be improved and expanded.

Besides the improvements mentioned in chapter 3, another possible expansion could be the comparison between the company's results and the competition, displayed in the application's dashboard, allowing users (i.e. marketing and client retention departments) to better understand and perceive the company's position in the market, while trying to understand what the competition's strategy is and the results it has brought them.

On the other hand, being one of the solution's main benefits, it would be interesting to allow the companies using the software to easily configure their own metrics and client data (i.e. through the dashboard), in order for the expert system's conclusions to better reflect their reality and business model.

On a final note, keep in mind that further improvements and features exist and should be studied, which leads the team to encourage the scientific community to further investigate and pick where this project was left off, allowing the proposed solution to reach its full potential and be of the utmost value to retail companies all over the world.

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