

APPLICATION OF INTELLIGENT METHODS IN COMMERCIAL WEBSITE MARKETING STRATEGIES DEVELOPMENT

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Abstract. Intelligent methods are widely applied in business, economical, financial, marketing and security aspects of e-commerce. The visitor is a vital element of eCommerce. Visitors' sources, data mining methods, types and application of intelligent methods in eCommerce are overviewed in this article. Neural networks application in traffic statistics analysis and marketing strategies development is presented.

1. Introduction

Artificial Neural Networks (ANNs) are powerful general-purpose software tools used for a number of data analysis tasks such as prediction, classification and clustering. They are based on abstract simplified models of neural connections. ANNs as instruments for solution of nonlinear problems already proved themselves well in business, economics, financial forecasting and marketing applications. Studies shows that 88 marketing related papers were published (0.24 percent of total papers on Neural Networks related research) in the NN field since 1999 to 2003 compared to 24 papers in 1994 to 1998[1]. Common topics in business, finance and marketing are customer relationship, bankruptcy prediction, inventory management, financial markets models [2], stock market investment models [3], customer choice models [4], forecasting and analysis of marketing data [6] and others.

This article focuses on eCommerce related neural networks application for website marketing strategy development. Website traffic data mining methods and marketing related NN based solutions are discussed here. In Section 2 eCommerce related neural networks applications and fields are introduced shortly. Section 3 discusses website traffic sources while Section 4 explains statistical data mining methods. These data are essential in website marketing strategies development, website profit and effectiveness increase. Section 5 introduces a neural networks based marketing strategy development model.

2. Application of Intelligent Methods in eCommerce and eCommerce Marketing

eCommerce is a relatively new field closely related to commercial activities and several areas of computer

science. Three main groups of e-commerce related NN's application fields may be mentioned. B2B – business to business related e-commerce, B2C – business to customer related e-commerce and both. In B2C e-commerce NN's are primary used for product selection and recommendation, negotiation, auctions, autoresponse generation, products and services pricing [7], customer marketing segmentation [5], etc. In B2B e-commerce artificial methods mainly are for supply chain management. However, website marketing solutions and website traffic analysis in conjunction with neural networks and other intelligent methods are important for all of these groups.

Traditional methods for marketing data collection are direct mailing, telephone interviews, focused group discussion and the like. Customers may be asked directly if they like or dislike a product, which features they would like to use and use not. Although these methods provide high quality data available, a significant number of work hours is required for such one-on-one interaction. It is expensive and time consuming. The rapid growth of the Internet creates an opportunity for direct online marketing research. Relative to methodology there may be several online marketing research types. The traditional are internet polls, products ratings, reviews, etc. The other way is website traffic statistics data mining and analysis. The main focus here is website visitor's browsing paths, called clickstreams, analysis. By analyzing these paths website marketing managers may take appropriate actions and find right solutions to increase website marketing effectiveness.

3. Website Traffic Sources

The lifeblood of every commercial website is highly targeted traffic. Two main groups of visitors can be distinguished here: first time visitors and

returned visitors. Both are very important and several marketing strategies are used to attract these visitors

into the website. The main website's traffic sources are listed in Table 1:

Table 1. Commercial Websites Traffic Sources

Visitor type	Marketing method	Description
First time visitors	Search engines	Keywords based. Websites are indexed by search engine robots applications (called spiders) and added into search engines databases. Visitors reach these websites by searching for information they are interested in. SEO (Search Engine Optimization) is required to list websites
	PPC, PPI	Pay per Click, Pay per Impression systems. Keyword based systems. Highly targeted, website related keywords must be chosen. Relatively to the marketing method a constant amount of money must be paid for a website link (banner) click or display.
	Directories	Links to a website must be placed into a highly targeted category of a directory. Visitors come by browsing categories of directories they are interacted in
	Link exchange / Ad Exchange	Direct links and banners exchange between websites.
	Direct marketing	Direct marketing through traditional media: Television, magazines, newspapers, telephone marketing etc.
Return visitors	e-mail subscriptions	Visitors subscribe to website's newsletter or e-zine systems. They are always in touch with company's announcements, products and services
	Fresh and attractive site content.	News, fresh and free information, products updates and downloads keep visitors back.

4. Website Data Mining Methods and Data Types

Visitors tracking and knowledge from where they come is essential in building website business, marketing and investment strategies. Two common models of website visitors tracking are: Server Side Tracking systems (Figure 1) and Client Side Tracking (CST) systems also known as real time tracking systems (Figure 2).

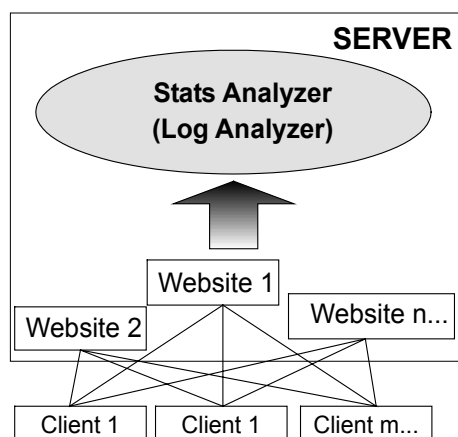


Figure 1. Server Side Tracking Model

The client side based tracking system has some noticeable advantages against server side tracking. First of all, information is collected in realtime, when the visitor browses a website and marketing manager may take actions and make marketing decisions at the same time when the visitor is browsing a website.

Secondly, it's more accurate because the visitor as unique is treated by client side unique ID, specifically generated for that visitor. While in server side tracking the visitor as unique is treated by visitor's computer IP which may be not so unique if the visitor is beyond firewall or proxy. Thirdly, in client side statistics tracking data are collected directly into the database. No additional logs analysis is required. This gives more easy input data preparation, management and computation. There where 54 different CST reports of statistical information analyzed and grouped into several categories [in this research](#) (Table 2).

Regarding to Table 2 the following may be analyzed/improved by CST statistics analysis:

- Visitors trend prediction.
- Website effectiveness. Design, Navigation, Operation, Speed.
- Website Marketing. Marketing Strategy, ROI on Marketing, New/Return Visitors Marketing Strategies, Marketing effectiveness, SEO.
- Business Strategy (Product line, Software upgrades, Sales).

5. Application of Neural Networks to Clickstream Analysis and Marketing Strategy Development

There are a number of fields and various aspects of commercial websites where intelligent methods applied to website statistics may help to solve or find possible problems and solutions. As mentioned before

it could be a website design, product price, software upgrades, etc. In this research, only one of all possible

applications was proposed leaving others for future investigation.

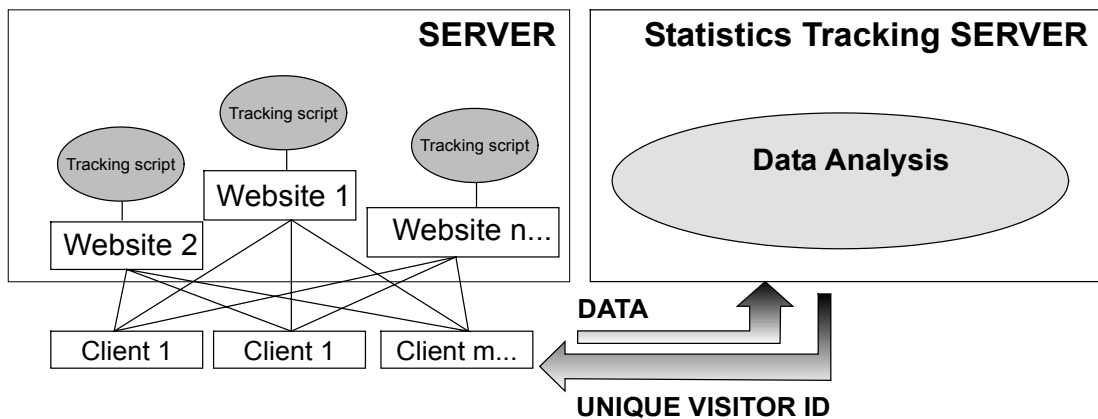


Figure 2. Client Side Statistics Tracking Model

Table 2. Website Tracking Statistical Data Groups

<i>Data group</i>	<i>Category</i>
<i>Client color coding and screen resolution</i>	<i>Website design</i>
<i>Entry/Exit pages</i>	<i>Website functionality (navigation)</i>
<i>Visitors browse paths</i>	<i>Website functionality(navigation)</i>
<i>Visitors client information</i>	<i>Website design, Website functionality(navigation)</i>
<i>Client OS platforms</i>	<i>Product (software)</i>
<i>Visitors' location. Countries by domains, IP</i>	<i>Marketing. Targeting by countries.</i>
<i>Visitors languages</i>	<i>Marketing. Targeting by Language. Product.</i>
<i>Visitors by day, month, quarter, year. Trends.</i>	<i>Forecasting. Investment. Product. Marketing.</i>
<i>Visitors by keywords and search engines.</i>	<i>SEO marketing.</i>
<i>Visitors by referrals</i>	<i>Marketing strategy.</i>
<i>Visitors by sales. Sales statistics.</i>	<i>Business strategy. Marketing. Pricing.</i>
<i>Repeat visitors, repeat customers.</i>	<i>Business strategy.</i>
<i>Transactions (subscriptions, purchases, etc.).</i>	<i>Business strategy. Marketing strategy.</i>

A NN based marketing strategy development model was created during this research to find which of marketing methods listed in Table 1 are the most effective and bring highly targeted and highly potential customers into a website. Neural networks as a possible solution were chosen due to their high efficiency in solving non linear problems because a clickstream to readable data mapping has a high non linear trend due to highly unpredictable website visitor behaviour. A CST based system was created and used for visitors' clickstream data mining in commercial website during this research. Over 200 000 clickstream data records were collected for analysis.

Clickstream paths typically have quite different characteristics compared to each other. However some similar patterns could be noted. Neural networks could be useful to extract these patterns and categorize

visitors. Mathematically visitor paths could be defined by the following equation:

$$[(P_{i,1}, t_{i,1})(P_{i,2}, t_{i,2}) \dots (P_{i,n}, t_{i,n})]$$

Where $i=1..m$ is a clickstream visitor creates while visiting a different page P on different time t. Visually the clickstream path could be treated as a pattern image (Figure 3).

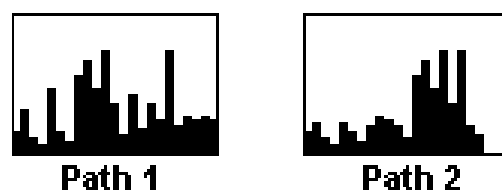


Figure 3. Clickstream Paths Treated as Images

When visitor goes through some website links path where purchases, registrations or some interest in are, the visitor could be treated as a potential customer or highly interested in services or products website provides. Our goal is to find and identify such patterns. Because the purpose of our research was to find which of marketing methods for the current website is the best, a number of valueless data was filtered first of all to create clickstream patterns rich training and testing sets. Then website pages most related to purchases and subscriptions were identified, and ranks were assigned to them. Highly purchase related pages as the “buy” page had the highest rank while others had lower ones. These ranks were used as target values in training sets to identify which visitors are highly possible customers for a single purchase, subscription or just highly interested in the content of the website. While ranks were assigned to most significant pages only, all pages were also indexed to create clickstream patterns suitable for neural networks. Finally the network input layer was constructed relative to the page index while the output layer was constructed to characterize and classify visitors to see which marketing method sends the most significant number of highly targeted visitors and potential customers.

5.1. Results

After input data, randomized training and test sets were prepared a three layer feed-forward neural network [8] was trained and tested. As expected the

neural network best performed with less number of hidden layer neurons and longer training times giving more stable and better results. With a larger hidden layers neurons number the network training was a bit faster. A less number of iterations was required to get the expected training level. The testing results were noticeably worse with a lower number of hidden layer neurons. The research results are shown in Tables 3, 4 and Figure 4. Table 3 shows website visitors distribution by visitor type. Table 4 shows visitors and visitor type distribution relative to the marketing method. As we could see the most effective marketing methods for the analyzed website are search engines, classifieds and directories. About 85 percent of highly targeted and content interested customers come from these sources.

Figure 4 shows how the neural network correctness level increased relative to the iterations number.

6. Possible Problems and Future Investigation

There are still a lot of place for investigation of intelligent methods application in eCommerce marketing and business related fields. Website design effectiveness, search engine optimization, keyword selection and products improvements could be the target for future researches. Practical neural network application to website clickstream analysis gave positive results, but a broader analysis should be done to prove its efficiency.

Table 3. Highly Targeted Visitors and Customers Distribution

<i>%</i>	<i>Visitor Type</i>
39.43	Highly interested in website and content.
21.98	Interested in content. Possible single product purchase.
2.50	Interested in single product purchase.
2.47	Highly potential customers. Single product or monthly membership.
0.22	Highly interested in single product and in selling company.
0.1	Highly interested in selling company and others testimonials before purchase of membership.

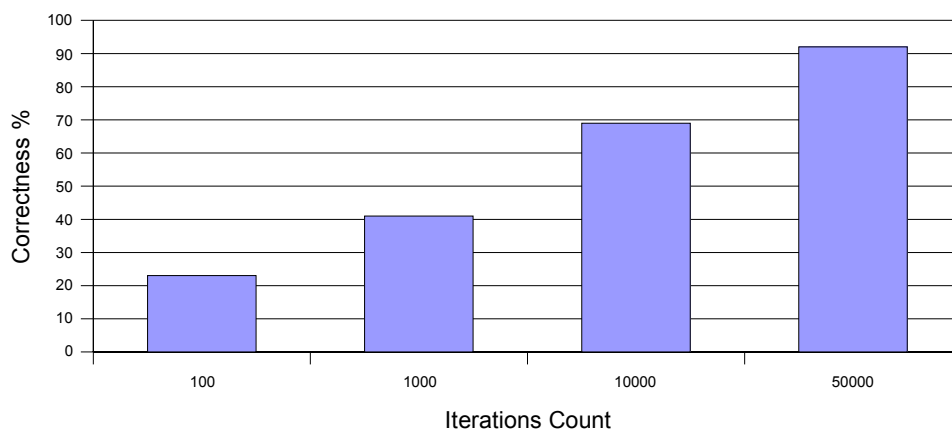


Figure 4. Neural Network Correctness Increase Relative to Iterations Number

Table 4. Highly Targeted Visitors and Customers Relative to Marketing Method

%	<i>Marketing method</i>
66,69	<u>Search engines</u>
40.45	Highly Interested in website and content.
4.64	Interested in content. Possible single product purchase.
2.59	Interested in single product purchase.
3.13	Highly potential customers. Single product or monthly membership.
0.24	Highly interested in single product and in selling company.
0.08	Highly interested in selling company and others testimonials before purchase of membership.
48.87	Others.
19.38	<u>Classifieds and directories</u>
32.61	Highly Interested in website and content.
56.6	Interested in content. Possible single product purchase.
10.79	Others.
9.43	<u>Direct</u>
2.01	Highly Interested in website and content.
50.05	Interested in content. Possible single product purchase.
2.33	Interested in single product purchase.
1.37	Highly potential customers. Single product or monthly membership.
44.02	Others.
4.93	<u>Link exchange and others.</u>

First of all, the input data and paths patterns should be reviewed. Additional information like clickstream time sequence could be analyzed for better results. Furthermore, the neural network hidden layer size should be minimized to reduce memory overload and to increase calculations speed. This will lead to website marketing real-time solutions to reduce website-to-visitor adaptation time to minimum.

7. Conclusions

Neural networks as non-linear problems solvers have gained confidence in business, finances forecasting, marketing and similar areas. That's one of the main reasons they should be suitable in solving eCommerce problems as well. Application and methods of using neural networks in eCommerce have been reviewed in this article; website clickstream, data mining and marketing method selection using artificial neural networks research have been proposed. Other possible fields of intelligent methods application have been identified.

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