



Using the Naïve Bayes Algorithm for web Design Cost Estimation with Content Management System

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Abstract— *Cyberspaces users exclusive increasing and considerable development in demands for website owners led to a new generation of metaphoric position whose managers with the least technical knowledge work by software packages of web which called Content Management system. By Content Management systems realizing, some factors such as domains, host space, pre-designed Module development, Graphics optimization and support became effective factors on software projects costs and projects under traditional webs and led to challenge for cost prediction models which were introduced previously. By respect to data mining capacity for discovering the hidden knowledge from data, in this article we represent a predictor model for websites cost estimation of Content Management systems by Bayesian algorithm with 55% precision in prediction and results were promising with respect to vacuum in the formal model for websites cost prediction.*

Keywords— *Cost Estimation, websites, CMS, naïve Bayes algorithm*

I. INTRODUCTION

Web sites in 3th millennium which named information technology and communication age is a considerable method for communication and information exchange facilities, free of space and time dimensions [1]. By respect to the dramatic growth of the internet and by respect to need to be available the companies and individual websites prepare the opportunity for organizations for presenting in an effective commercial competition and remove its limits and lead to employment and income creation [2]. Metaphoric position can help governments for transferring the large part of official original services in order to decrease the size of government and its efficiency increasing and increasing satisfaction [3]. A website when is showed in passage for users, phases of a perfect way of software production but by limitation and individual challenges [4]. By respect to this fact that each software project from the beginning doesn't have any goal except success and reaching to determine cost and time, regular methods and management strategies in software production and project management are a basic principle [5]. Web Design Projects also a subset of software projects which are under respected to desire principals of project management. One of important concepts in project management is a time and cost estimation in the initial phase. Getting far from this principle leads to illogical estimation, false planning, false and unreachable expectation for owners and leads to dissatisfaction for both sides [6]. Web Design Projects which installed by persons or companies should be satisfied for spending cost and time that's why cost estimation is an important principle which determined probable profit or loss of order for both sides. However web designing projects with traditional software projects are the initial goals of production cycle they are different of project sizes and other concepts [7] but by exclusive increment of internet users web designers with respect to demands increasing move toward production and software system used for web making which named Content Management which is different in designing and project management [8]. In this article, we tried to represent a method for cost estimation for websites which uses Content Management systems by promoting methods of data mining. At first we analyzed activities for websites cost estimation by Content Management system and then identify them by works with them and effective parameters in the effective cost estimation of total costs then we estimated websites cost by a naive Bayes algorithm which is data method and finally analyzed the results.

II. PREVIOUS WORK

In worldwide researchers, scientific institutes and valid universities researched on a model of cost estimation for software's under web and websites designing and implementing their results were represented as articles in journals and scientific conferences. But by respect to be new the Content Management it was not studied so much. However commercial companies from competition in web designing and users demand increasing and by expert information considered parameters and presented cost estimating systems on their websites based on their expert's opinion and we

review them in this section. A valid company [9] considered the parameters of cost estimation of software projects number of pages , site promotion , picture, Optimization and edit for online galleries , form number , management online Modules , related subjects , weblog supporting , ability for information getting of the forms , promoted search functions , RSS/XML concepts link , e-commerce supporting , and online payment and graphic design and hosting costs and finally repair and keeping methods.

The other company [10] by designing phase's division, estimated cost of software projects. In basic designing kind of index page designing and additional pages were considered. In the script part with PHP, Perl, ASP languages number of scripts in desired languages are important. In another section by Java scripts separation of their number considered as separated cost functional. In data designing section, the number of data position was analyzed. In designing sections, number of Flash files were counted and in site Optimization, for searching motors 10 top sites were considered. In addition, site recording for searching motors was considered as another parameter. By estimated costs sum we can predict total cost. Prediction the cost in another company [11] works based on logo design cost, graphic design cost, pages number, concept, pictures, flash files and online picture gallery. Furthermore in this model costs of designing for online classes and information results, e-commerce supporting and Content Management systems contribute in present projects cost prediction.

III. CONTENT MANAGEMENT SYSTEMS

Websites size and complexity have grown in recent years and need to more resources. Some researchers in industry estimated that some pages of web in large websites are being twice in each year [12]. We need to support for website development. Web sites have other scopes such as profession relations, Multilanguage websites and internet. Number of persons who increase different concepts will be increased. They may have different methods for delivery and writing. There are some demands for personal concepts and performance addition to websites and then different media need to common management in text and picture [13]. That's why Content Management of a website is a compulsory priority. Totally, software of Content Management is installed on the server's web and users can enter their scopes with different access rights. When a user enters into it, can produce, correct and distribute the concepts and information based on his access right its named managerial role and present for all managing systems. Then, websites can be spread by access protocols [14]. Content Management software or CMS is a program which supports perfectly of creation, management and upgrading a website and has all tools for a site management. CMS includes life cycle a web page from creation and upgrading until the end. It has also an ability for management of site structure, page representing manner and their relation with menu [15].

IV. WEBSITES COST ESTIMATION WITH DATA MINING

Systems of Content Management in designing lead to large changes in traditional models for estimating the costs of designing projects in websites till most of used parameters in last methods remove, optimize, correct, and upgrade. It also works as one of the vast and high used branches of artificial intelligence, machine learning for regulating and discovering the methods and algorithms and based on its computers can train and learn [16]. By Bayesian theory which is training branch in machine learning this model of learning [17] ability among the last projects passes its training way and with high efficiency in new projects based on Content Management systems and corrected , removed , and added parameters can design and predict accurately the costs of websites designing. Artificial intelligence technics for websites cost estimation based on Content Management systems and based on studied is used firstly.

In this article we considered new concepts such as costs of modern graphic designing for the addressees absorbing as one of effective parameters in predicting the costs of web designing, by respect to this fact that last models ignored the amount of recording costs , extension , technical and commercial ownership of the domains and hosting costs and bandwidth because projects under ordered web will be implemented on their customer's private servers. By respect that in today's age there is economic asceticism, production and keeping the server web and DNS is not cost effective. In addition persons and companies and small agencies which need to have websites don't want to prepare server webs for themselves because today's metaphoric private servers and hosting plans are rented for them.

We attended to domain and hosting costs as one of the effective parameters in final costs of software projects. in most of today's websites program writing and execution are not started from zero and by Content Management systems installing they are developed based on their needs .That's why we consider basic execution costs as correction and cost of Module development for Content Management systems. They include pictures gallery, film gallery, referendum systems, speech saloons, conversation rooms, slide show systems, counter systems, SMS systems, e-commerce systems and connectivity to payment networks.

Furthermore, today with search engine development being in the top searched scores is important to absorb addressees. Thus websites based on Content Management systems should record in the directory for Optimization search motors. We considered correction and Optimization cost of Content Management systems and its Modules for search motors as effective parameters which are not seen in other studies of projects under webs and estimation of costs in Content Management systems. After considering these factor costs of software projects will be assessed and in next references technics of artificial intelligence can estimate current costs by high efficiency with learning and models of last projects.

A. DATA COLLECTION

After classifying all data, we tried to collect information on 100 projects of web designing in professional companies of web designing or designed websites by real persons. In information collection we attended to projects which used

Content Management systems and we didn't use other private scripts. These information related to web designing companies in south and web designers of this area of Islamic republic of Iran. We considered websites domain as the first effective parameter on costs and put them in 2 classes with respect to costs of the domain record in Iran based on differences and similarities which are seen in table 1.

Table 1: Classification of domains based on costs

Domain Type	Domain		
World Domain	.net	.biz	.info
	.ws	.com	.org
National Domain	.ir		.co.ir
	.sch.ir		.ac.ir

Second parameter that we considered effective is hosting services of websites. In this article with respect to websites kind and amount of used space and traffic proportional with them we put hosting services in 6 classes whose details are in table 2.

Table 2: Classification of domains based on costs

Service 1	Service 2	Service 3
space:250MB	space:500MB	space:1GB
Traffic:4GB	Traffic:6GB	Traffic:8GB
Service 4	Service 5	Service 1
space:2GB	space:3GB	space:4GB
Traffic:10GB	Traffic:12GB	Traffic:15GB

We considered kind of Module development in Content Management systems as the third parameter. Their development is done proportionally to kind of websites we consider kind of website as an indicator of kind of Module development whose classes are in table 3.

Table 3: Classification of web sites Based on modules developed

Type of Website	Modules Development
Personal	Development and Programming Blog Modules based on individual needs
Commercial	Development of e-commerce and online payment module
Corporate	Develop modules for customer relationship management
Portal – News	News Module Development and Search Engine

We put design, translation, edit costs of template of Content Management systems in classes which are in table 4.

Table 4: Classification based on design templates for content management systems

Plan Name	Description
Edited	Edit and change the default graphical template
Translation	Template Translated from English to Persian
Bronze	HTML + CSS + Intermediate Graphic Design
Silver	HTML + CSS + JQuery + Professional Graphic Design
Gold	HTML + CSS + JQuery + PSD+ Professional Graphic Design
Custom-made	Template customization facility utilizes the most advanced methods and WEB 2

Another effective factor on total costs of websites based on Content Management systems is kind of Optimization for rank increasing and loading speed increasing in websites which are in table 5.

Table 5: Classification based on website optimization work done

Activities to optimize	Plan 1	Plan 2	Plan 3	Plan 4
Submit website in search engines	✓	✓	✓	✓
Registration of web pages in search engines	✗	✗	✗	✓
Registration site in directories	✗	✓	✓	✓
Submit news with potential SEO issues	✗	✗	✓	✓
Feed	✗	✓	✓	✓

Analyst reports Google	✘	✓	✓	✓
Keyword performance report	✓	✓	✓	✓
Website statistics and analysis report input	✓	✓	✓	✓

Each website which represented to customers as Content Management system needs to guide and support for managing and even to technical development based on new needs of customers. Based on activities for supporting and kind of experts and total costs we classify them whose details are in table 6.

Table 6: Classification Based on Support Services Hours

Plan Name	Service
Plan 1	5 hour support
Plan 2	10 hour support
Plan 3	20 hour support
Plan 4	50 hour support

Finally we classified total cost of design, development, and supporting the websites which used Content Management systems based on people's ability in payment and amount of incomes whose details are in table 7.

Table 7: Classification costs for all Web-based content management system

Costs Range	Spending (RLS)
Range 1	6 million RLS to 13 million RLS
Range 2	13 million RLS to 18 million RLS
Range 3	18 million RLS to 23 million RLS
Range 4	23 million RLS to 38 million RLS
Range 5	28 million RLS to 32 million RLS

Comprehensive information of projects based on classify in tables 1-7 are in table 8.

Table 8: General information about web design projects Based content management system

	Domain	Hosting Plan	Type of website	Template	SEO Plan	support plan	Cost Range
1.	Global Domain	Plan 1	Personal	Edited	A	A	Range 1
2.	Global Domain	Plan 2	Personal	Silver	B	A	Range 1
3.	Global Domain	Plan 2	Personal	Silver	A	A	Range 1
4.	Global Domain	Plan 2	Personal	Silver	C	B	Range 2
5.	Global Domain	Plan 1	Personal	Edited	A	B	Range 1
6.	Global Domain	Plan 3	Personal	Silver	D	A	Range 3
7.	Global Domain	Plan 2	Personal	Translation	B	A	Range 1
8.	Global Domain	Plan 3	Personal	Silver	B	B	Range 2
9.	Global Domain	Plan 4	Personal	Custom-made	C	D	Range 3
10.	Global Domain	Plan 1	Personal	Edited	A	A	Range 1
11.	Global Domain	Plan 2	Personal	Bronze	B	C	Range 2
12.	National Domain	Plan 3	Personal	Gold	C	D	Range 3
13.	National Domain	Plan 1	Personal	Edited	A	A	Range 1
14.	National Domain	Plan 1	Personal	Translation	A	A	Range 1
15.	National Domain	Plan 2	Personal	Bronze	B	B	Range 1
16.	National Domain	Plan 1	Personal	Translation	B	B	Range 1
17.	National Domain	Plan 3	Personal	Bronze	A	C	Range 1
18.	National Domain	Plan 2	Personal	Silver	A	B	Range 1

19.	National Domain	Plan 4	Personal	Gold	D	D	Range 3
20.	National Domain	Plan 4	Personal	Custom-made	D	C	Range 3
21.	National Domain	Plan 2	Personal	Bronze	A	A	Range 1
22.	National Domain	Plan 2	Personal	Bronze	A	A	Range 1
23.	National Domain	Plan 3	Personal	Gold	B	C	Range 1
24.	Global Domain	Plan 3	Corporative	Bronze	B	C	Range 2
25.	Global Domain	Plan 4	Corporative	Bronze	D	C	Range 3
26.	Global Domain	Plan 5	Corporative	Custom-made	B	C	Range 4
27.	Global Domain	Plan 6	Corporative	Bronze	D	A	Range 3
28.	Global Domain	Plan 6	Corporative	Silver	A	C	Range 2
29.	Global Domain	Plan 5	Corporative	Silver	B	C	Range 3
30.	Global Domain	Plan 5	Corporative	Silver	C	D	Range 3
31.	Global Domain	Plan 4	Corporative	Silver	C	D	Range 3
32.	Global Domain	Plan 4	Corporative	Silver	C	D	Range 3
33.	Global Domain	Plan 4	Corporative	Gold	D	C	Range 4
34.	Global Domain	Plan 4	Corporative	Gold	C	B	Range 3
35.	Global Domain	Plan 4	Corporative	Custom-made	D	B	Range 4
36.	National Domain	Plan 3	Corporative	Gold	B	C	Range 3
37.	National Domain	Plan 6	Corporative	Gold	C	D	Range 4
38.	National Domain	Plan 5	Corporative	Gold	D	B	Range 3
39.	National Domain	Plan 5	Corporative	Custom-made	C	D	Range 4
40.	National Domain	Plan 5	Corporative	Custom-made	B	D	Range 4
41.	National Domain	Plan 4	Corporative	Custom-made	D	D	Range 4
42.	Global Domain	Plan 6	Commercial	Custom-made	D	A	Range 6
43.	Global Domain	Plan 6	Commercial	Gold	B	A	Range 3
44.	Global Domain	Plan 6	Commercial	Gold	C	C	Range 4
45.	Global Domain	Plan 6	Commercial	Custom-made	D	A	Range 6
46.	Global Domain	Plan 6	Commercial	Gold	D	C	Range 5
47.	Global Domain	Plan 6	Commercial	Gold	C	A	Range 4
48.	Global Domain	Plan 6	Commercial	Custom-made	D	C	Range 6
49.	Global Domain	Plan 6	Commercial	Gold	D	D	Range 5
50.	Global Domain	Plan 6	Commercial	Gold	C	B	Range 4
51.	Global Domain	Plan 5	Commercial	Custom-made	D	D	Range 6
52.	Global Domain	Plan 5	Commercial	Custom-made	D	B	Range 5
53.	Global Domain	Plan 5	Commercial	Gold	D	D	Range 5
54.	Global Domain	Plan 5	Commercial	Silver	C	B	Range 4
55.	Global Domain	Plan 5	Commercial	Custom-made	D	D	Range 6

56.	Global Domain	Plan 5	Commercial	Custom-made	C	B	Range 5
57.	Global Domain	Plan 5	Commercial	Bronze	C	D	Range 4
58.	Global Domain	Plan 4	Commercial	Gold	D	A	Range 4
59.	Global Domain	Plan 4	Commercial	Gold	C	D	Range 4
60.	National Domain	Plan 4	Commercial	Custom-made	C	D	Range 5
61.	National Domain	Plan 4	Commercial	Gold	C	C	Range 4
62.	National Domain	Plan 4	Commercial	Silver	C	C	Range 3
63.	National Domain	Plan 5	Commercial	Gold	C	C	Range 4
64.	National Domain	Plan 5	Commercial	Custom-made	D	B	Range 6
65.	National Domain	Plan 5	Commercial	Silver	C	B	Range 3
66.	National Domain	Plan 5	Commercial	Gold	D	B	Range 4
67.	National Domain	Plan 6	Commercial	Gold	B	D	Range 4
68.	National Domain	Plan 6	Commercial	Custom-made	D	C	Range 6
69.	National Domain	Plan 6	Commercial	Custom-made	C	A	Range 5
70.	Global Domain	Plan 6	Portal	Custom-made	D	D	Range 6
71.	Global Domain	Plan 6	Portal	Gold	D	B	Range 5
72.	Global Domain	Plan 6	Portal	Gold	D	D	Range 5
73.	Global Domain	Plan 6	Portal	Custom-made	D	A	Range 6
74.	Global Domain	Plan 6	Portal	Gold	D	D	Range 5
75.	Global Domain	Plan 6	Portal	Gold	D	D	Range 5
76.	Global Domain	Plan 6	Portal	Gold	D	A	Range 5
77.	Global Domain	Plan 6	Portal	Gold	D	A	Range 6
78.	National Domain	Plan 6	Portal	Gold	D	D	Range 6
79.	National Domain	Plan 6	Portal	Custom-made	D	B	Range 6
80.	National Domain	Plan 6	Portal	Silver	C	D	Range 4
81.	National Domain	Plan 6	Portal	Silver	C	B	Range 4
82.	National Domain	Plan 6	Portal	Silver	C	B	Range 4
83.	National Domain	Plan 6	Portal	Silver	C	D	Range 4
84.	National Domain	Plan 6	Portal	Silver	C	C	Range 4
85.	National Domain	Plan 6	Portal	Gold	D	C	Range 5
86.	National Domain	Plan 5	Portal	Custom-made	D	D	Range 6
87.	National Domain	Plan 5	Portal	Custom-made	D	C	Range 5
88.	National Domain	Plan 5	Portal	Custom-made	D	C	Range 5
89.	National Domain	Plan 5	Portal	Custom-made	C	D	Range 6

90.	National Domain	Plan 6	Portal	Custom-made	D	C	Range 6
91.	National Domain	Plan 6	Portal	Bronze	C	C	Range 4
92.	National Domain	Plan 6	Portal	Custom-made	C	C	Range 6
93.	National Domain	Plan 6	Portal	Bronze	C	A	Range 3
94.	National Domain	Plan 6	Portal	Bronze	C	C	Range 4
95.	National Domain	Plan 6	Portal	Custom-made	D	B	Range 6
96.	National Domain	Plan 6	Portal	Gold	C	D	Range 4
97.	National Domain	Plan 6	Portal	Custom-made	D	C	Range 6
98.	National Domain	Plan 6	Portal	Custom-made	D	C	Range 6
99.	National Domain	Plan 5	Portal	Custom-made	C	D	Range 6

V. NAÏVE BAYES ALGORITHM

One of the most important tools for execution different technics of data mining is Bayesian theory. Bayesian theory is a fundamental statistical method for identifying and classifying. It creates peace between different class's decision and their costs and then selects the best. Thus for that we require that probable distribution functions and their related amounts be clear. Bayesian learning algorithms work on different supposes probability. Naive Bayes algorithm is a probable learning algorithm which derived of Bayesian theory and is a kind of classifying which works based on classes probabilities [18].

An applicable method of Bayesian learning is Naive Bayes method .in some scopes its indicated that its efficiency is comparable with efficiency of methods such as nervous network and decision tree. Naive Bayes classifying for problems in which each x sample is selected by a set of adjectives and goal function f(x) from a set such as v is applicable. Its manner for new sample classifying is that identify the most probable class or goal amount v_{MAP} by adjectives amount $\langle a_1, a_2, \dots, a_n \rangle$ which explain new sample and represented in equation 1 [19].

$$v_{MAP} = \arg \max_{v_j \in V} P(v_j | a_1, a_2, \dots, a_n) \quad (1)$$

By Bayes theorem above text can be rewrite following:

$$\begin{aligned} v_{MAP} &= \arg \max_{v_j \in V} \frac{P(a_1, a_2, \dots, a_n | v_j) P(v_j)}{P(a_1, a_2, \dots, a_n)} \\ &= \arg \max_{v_j \in V} P(a_1, a_2, \dots, a_n | v_j) P(v_j) \end{aligned} \quad (2)$$

With training data we try to estimate 2 sentences of above equation now. Calculation is easy by training data, means how much is the amount of repeating v_j in data. But different sentences $P(a_1, a_2, \dots, a_n | v_j)$ in this form is not acceptable unless we have many learning data. It's a problem that number of these sentences is equal to number of possible samples multiply number of goal function. Thus we should observe each sample several times to gain suitable estimation. It suppose that adjectives amount are conditional independent amount of them.in other words by observing output of goal function , probability of adjectives observing a_1, a_2, \dots, a_n is equal with each adjective probability multiplying separately.by replacing it to above equation results naïve Bayesian method.

$$v_{NB} = \arg \max_{v_j \in V} P(v_j) \prod_i P(a_i | v_j) \quad (3)$$

When v_{NB} is output of naïve Bayesian classify for goal function. Note that sentences number $P(a_i | v_j)$ is equal to adjectives number multiply output number for goal function which is less than $P(a_1, a_2, \dots, a_n | v_j)$. It means naïve Bayesian learning tries to estimation different amounts $P(v_j)$ and $P(a_i | v_j)$ with amount of their repeating in training data. This set of estimations are proportional to suppose. It is used for classifying new samples by formula 3.

VI. DISCUSSION

In this step we model after collecting information and prediction. We have web designing projects based on new Content Management systems whose information such as the kind of domain, host amount, kind of website, a kind of frame, a kind of Optimization and amount of supporting is clear. We want to make a system which predicts this website is in which cost dingle. We have goal variable and want to predict it. Therefore we collected some information in different methods which used in models assessing and comparing. A method of data division is a large volume of data and our experience. We divided 80% data for modelling and 20% for models tested.

Naïve Bayes is instance-based or lazy [20] in which all training samples are stored at first and classifying will not be done unless an unknown sample needs to it. we implanted a software of naïve Bayes for prediction websites cost of Content Management systems same table 8, then we tested the model till show accuracy of a naïve Bayes algorithm in prediction web projects cost based on Content Management system same table 9.

Table 9: Accuracy of the naïve Bayes algorithm to predict the cost websites with Content Management Systems

Number of projects that have been correctly classified	11 Project	55 %
Number of projects that are not classified correctly	9 Project	45 %

In this study we assessed the use of revolt matrix which represents samples of a class that are classified in similar class or other classes. by this matrix we can observe special samples which were classified false or truly. in table 10 it's showed.

Table 10. Matrix confusion of naïve Bayes classifier to predict the cost websites with Content Management Systems

	Range_1	Range_2	Range_3	Range_4	Range_5	Range_6
Range_1	2	1	0	0	0	0
Range_2	1	1	0	0	0	0
Range_3	0	0	1	2	0	0
Range_4	0	0	2	2	0	0
Range_5	0	0	0	1	1	2
Range_6	0	0	0	0	0	4

For assessing the prediction accuracy and classify algorithm some concept are used in data mining techniques. Precision is relation of all cases of a class to all cases about that class. Recall is relation all cases of class x that accurately classified to all cases of that class. F-measure is a weight of accurate. TPR is number of positive data to all data. FNR is number of positive data with bad classifying to all data [21]. All information is in table 11.

Table 11: Evaluation of naïve Bayes classifier to predict the Cost of websites with Content Management Systems

	Range_1	Range_2	Range_3	Range_4	Range_5	Range_6
TPR	0.667	0.5	0.333	0.5	0.25	1.0
FNR	0.333	0.5	0.667	0.5	0.75	0.0
Precision	0.667	0.5	0.333	0.4	1.0	0.667
Recall	0.667	0.5	0.333	0.5	0.25	1.0
F_Measure	0.667	0.5	0.333	0.444	0.4	0.8

VII. CONCLUSION AND FUTURE WORK

Content Management systems lead to creation, upgrade, supervision, and spread of concept and data on the websites without needing to skill and knowledge for users. These systems have several advantages and change cost of web projects production from human resources, code complexity, and pages number to some other costs such as Module development and lead to less personal, easy work, and expert's presence. Totally, Content Management systems considered concepts such as domain kind, hosting space, site Module kind, graphic and frame, Optimization and supporting. so far many methods have been presented for estimating the cost of web projects. But in some aspects that are not so efficient. Today, by respect to conceptual development means data mining for hidden knowledge of data and unknown patterns some activities such as prediction and classifying are easily done. Data mining with different methods and patterns and here we represented naive Bayes method for a software model in cost prediction, has ability of training and learning from last projects and is effective for new costs identification. In this project we used 90 project information and showed that naive Bayes algorithm with 55% accuracy can predict the costs for new projects and is promising. We will try to promote correction and accuracy. our future works is combination of algorithms for data mining with new ones from nature in Optimization problems. last experiences indicated that this combination is promising. We also try to identify other technologies in web designing and use them in total cost estimation.

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