Intelligent Quality Assessment Model of News Sites (NEWSQUAL)

Hamid Jafary*
Information Technology Management
Allameh Tabataba'i University, Ph.D. Student
Tehran, Iran
h.jefry@gmail.com

Payam Hanafizadeh
College of Management and Accounting Management
Allameh Tabataba'i University, Associate Professor
Tehran, Iran
hanafizadeh@gmail.com

Mohammad Taghi Taghavifard
College of Management and Accounting,
Allameh Tabataba'i University, Associate Professor
Tehran, Iran
dr.taghavifard@gmail.com

Abolfazl Kazazi
College of Management and Accounting
Allameh Tabataba'i University, Professor
Tehran, Iran
kazazi@atu.ac.ir

Abstract— **Effective measurements and accurate analysis of the quality of news sites are the necessary steps in improving the sites' performance and reporting methods. The present research was conducted to propose an intelligent quality assessment method for news sites. This study consists of two parts. In the first part, the Delphi technique as a qualitative method is used to identify the indicators for assessing the quality of news sites. For this purpose, 5 dimensions, 69 indicators, and several sub-criteria from five perspectives of design and graphic design, content, technical system, services, and executive management of news sites were identified. Subsequently, the quality of 61 news sites was calculated and the quality score of each site was obtained using a questionnaire. In the second part, a neural network model was designed with 9 inputs and one output. The results and the values of Mean Squared Error (MSE) indicate the validity of the proposed model.**

Keywords— Intelligent; Evaluation; Service Quality; News Sites; Neural Network; ANFIS.

1. INTRODUCTION

Formation of social life and interaction of people for common life and business have led to emerging several industries in real space. As a result, any industry requires marketing and interaction with other companies in order to provide primary materials and sell its products and manufactured goods. Due to limitations and low extent of physical space, various industries referred to virtual space for marketing and contact with their audiences all around the world. Therefore each company seeks to establish an Internet site and system and have an active presence in virtual space alongside physical space. Today, some of these industries exclusively work on virtual space.

The news is among the most important textual information source that was originally in the form of newspaper, weekly, quarterly and annals published in particular and limited circulation with exorbitant cost and provided for certain audiences. In the information and communication era, the interaction of people with each other has increased. Moreover, Internet expansion and transmission of information in a short time have caused the movement of the printed matter toward Internet space, news agencies and design of related news sites so that they have an influence on the audience. Although administrators of the press and newspapermen are active on the Internet, the presence of printed matters has not decreased in physical space and these printed materials also have their own functions.

Today, the first contact of the customer with a company is often its Website. A website, like the showcase of a store, presents a given organization or institute to all the world. Thus, it is regarded as the most important informational bearer of the organization [1]. The website has some advantages such as flexibility and up-to-date information. Obviously, the better the organization can exhibit itself in this medium, the more successful it will be an achievement to its purposes.

After creating news sites and updating its content, it should be paid attention to the way of marketing and attraction of the audience. Therefore, news sites are of importance from two aspects; the first is the view of administrators and technical manufacturers of news sites and the second, which is more important, is the satisfaction of audiences and main customers. Their satisfaction depends on different factors and criteria that are related to various aspects of a news site.

There are some general criteria for assessment of electronic information resources and a number of these criteria are important for specific sort of resources. For instance, concerning examination and assessment of a website, the identification of available information's credit might be important; however, for someone who uses archives and data banks, the speed of access to information is more important. There is sort of resources on the Internet known as websites including general and specialized electronic magazines, complete text resources of databases, the news and informational resources, advertising, commercial information, multimedia resources, and other names that each of them should be examined considering own specific features. Presently, the assessment of websites

and their available information is a significant global issue in educational institutions [2].

The design of a website should be able to satisfy users by the presentation of comparative and personal services. Moreover, it should increase the probability of return and the rate of their use from the related website. Therefore the way of presenting information and services to the user is of great importance for disappearing dissatisfaction and also creating satisfaction from websites. So, presented information on web pages should have the logical order and certain structure.

The main objective of this research is to develop an intelligent and completely mechanized model for evaluation of news sites' quality regarding culture, policy, custom, and tradition of our country, without the interference of provisional policy of ruling government and manpower. Results of this research can help administrators of news sites to increase the quality of these websites.

2. LITERATURE REVIEW OF RESEARCH

In this section, we consider literature and investigations which is related to research's subject.

2.1. Service Quality

Exact definition of the 'Quality' word is difficult and ambiguous. Based on Quality system 2000, all of the features that meet customer's need are known as Quality. So any product or service which has features of customers' need provider can be regarded as high-quality product or service. It's not difficult to define and assess the quality of physical goods, and their quality can be evaluated by determination of quantitative standards. However, discussing quality is very difficult in work service part. On the other hand, concept of service is a complicated concept and service quality is also more complex [3].

As a simple definition, service quality is that audiences make a comparison between judgement of own expectations and services which they have perceived receiving them [4].

2.2. Assessment of services quality

There are various models in quality literature for assessment of services quality. For example, it can be referred to Gronroos or North model, Dabholkar et al model, Letnin model, Hierarchy of service quality model, Service quality or ServQual model, Internal service quality model, ServPerf model, Johnson model, Rust and Oliver model, The Balanced Scorecard model, Ghobadian model, Speller and Jones, Bay et al model, Johnson et al model, and etc. Quality assessment of services organization is expressive of presented service to what extent can meet customers' expectations. In service receiving process, customer is usually present and it means that customer perception of quality not only is affected from use of service, but it's also affected from process of service presentation. The perceived quality is a spectrum which one side of it is ideal quality and the unacceptable quality is on the other side. In presented service quality evaluation, these perceptions are put alongside customer expectations.

In spite of high stability and reliability of related models, researchers believe that in applied cases they should be utilized in a modified way. For instance, efficacy of ServQual model is approved in trade environment but application of this model in a non-profit environment such as library proved that some of it's provisos are not proportional to library invironment. Therefore, generality of ServQual about it's conformity to a special service organization like library excited dubieties that owing to them, some informatics and librarianship researchers provided more exclusive and suitable tools for analysis of library service split. Based on multiple interviews with users of libraries, these actions resulted in renewal of ServQual tools structure. Consequently, LibQual, exclusive tool of libraries quality assessment, is compiled, experimented, and purified by association of research libraries. At present, use of LibQual tool for recognition of libraries' users expectations, study and analysis of split between their expectations and their conception of received services, is the most common method that is applied to evaluate libraries service quality. In addition to United States, Canada, Australia, England, Ireland, and Scotland, LibQual tool has been applied to different languages in other various countries [5].

2.3. The Kinds of Website

Various systems have been created and applied on Internet space. Website is one of systems which has extremely use. According to McMurdo, websites are divided into five groups:

- Governmental websites that try to affect public opinions.

- Commercial websites that try to promote or sell productions.

- News websites which their purpose is gathering of up-to-date information.

- Informational websites that their purpose is presentation of real data.

- Personal websites that are created by one person and it's possible to depend on an institution or not.

In addition to classification of McMurdo, that is governmental, news, commercial, informational, and personal websites, educational and services websites have been also considered. Service websites deal with presentation of Internet services and extension of Internet use in country. Educational websites, in reality, are subclass of informational websites that propagate and present data which are related to an educational institution or organization [6].

2.4. News definition

Newspapermen and researchers of this area have expressed different definition of news. Access to a common and comprehensive definition, in other words a comprehensive theory, for news is so complicated. However, Doctor Younes Shokrkhah, founding father of Iran electronic journalism, in his book by the name of "News" defines that:

News is an impartial, exact, and also true and actual report about a supposed event. He says, "news is a social right, and not a social goods".

2.5. The Values of News

It is possible that an event be news in the eyes of someone but it do not be the news for others at all or it completely be unimportant.

The importance of cognition of news values is that it can help reporter to recognize and understand the news (subject tracking), and help him for arrangement of news. Moreover, recognition of news values can be utilized as criterions for comparison, valuation, and selection of daily events (with regard to prioritizing, place on the page, size of headline and etc.) In general, the values of news include: [7]

1.Effectiveness: An event has an effectiveness value when it is effective on behaviour or attitude of lots of society people at present or in future. Effectiveness of an event may cause either material or spiritual profit or harm of people of a society. An event can have a direct or an indirect influence on people.

2.Renown: whenever real and legal individuals and even some objects are known in the national and international society because of their fame and activities, they have the value of news. Renown may have positive or negative meaning. Individuals and institutions of society and some objects, including living and lifeless, are not similarly famous, so they do not have the same news values. On the one hand there are social, cultural, political, and religious personalities, on the other hand there are inanimate and solid things or public and private departments and organizations that are known among people owing to their activities or services, these contain one aspect of news.

3. Conflicts, Disputes, Involvements, Quarrels: These events include conflict (dispute, scuffle or involvement) among individuals, groups, nations, animals in nature with each other. Conflict may be bodily (physical) or mental and ideological. Tens of reports containing this aspect of news (alone or combined with other news values) are published on newspapers every day. This news value is important because it's possible that these conflicts disturb the existing balance in the society and this will have influence on individuals' material and spiritual security.

4. Exceptions, Wonders: They are uncommon, exceptional, strange or rare events. In some cases, these events occur unlike prediction or expectation.

5.Greatness and Largeness of Number and Amount: This news value is related to numbers and statistics. Numerals may be number of persons or extent of financial or life damages. However number or amount increases, importance of this news value will increase.

6.Adjacency: As an event that is news for somebody can not probably be news for others, events that are news for inhabitants of a city may have no news value for other city. Adjacency can have news value for audiences in two ways.

- **Geographical adjacence:** audiences primarily tend to know about events of city or country that they live there, then other countries. Regarding this aspect of news value, however events' distance is farther of city which audiences live in it, it's news value is less.

- **Spiritual adjacence:** an event that is happened in a far place, can have news value for audience, whereas that event relatively be concerned with language, culture, religion and another interests and beliefs of him. In other words the event should have spiritual adjacence value.

7. Time or Novelty of Event: Time of occurrence or novelty of event gives the news matter particular value. If an event which has occurred today is not reported in a moment, it will joine the history in the eyes of journalism profession.

2.6. History of Research

In websites assessment area, many researches are accomplished inside and outside of the country. Each of the researches has applied different methods and models in proportion to sites content. It is referred to a number of these researches:

Gharibeniazi et al (2015), in an article by title of " Websites Quality Evaluation Methods: Web QEM and WAI" has explained websites assessment methods, WebQEM and WAI. She explained the sorts of websites quality assessment method By using of librarian study and concluded that utilization of quantitative methods for evaluation of websites quality can be important owing to reduction of human errors and intervening variables. This is time-saving and obtains more careful results in evaluation [8].

Arman, Sohrabi and Manian (2016), in an article by title of "Evaluation of Most Visited News Websites in Iran Based on Machine Learning" have used one of the multi criteria decision-making methods called TOPSIS for 791 ranking news websites and they have achieved the weights of the criteria on entropy method [9].

Ziemba et al (2015) in an article named "Integration of Websites Evaluation Methods" express that there are many methods for evaluation of website quality. While they can be used for a variety of purposes and needs with different approaches, it is not easy to choose a proper and suitable method for needs. This study focuses on a structure of knowledge treasury about websites quality assessment methods. This treasury, like a collection, comprises various methods from quality evaluation and it makes possible to choose the best. Proposed approach has been reviewed with main methods and ontological results that can treat like an accumulator of knowledge [10].

Park et al (2016) in a research by the title of "Supporting Comment Moderators in Identifying High Quality Online News Comments" express that users' comments are recorded online by news articles readers and this can be valuable criticism, feedback and personal view. It can also give an opportunity for decision-making. These comments obligate publishers to eliminate low qualities, however, following them there is an intelligent

development that can improve the usual quality of society by distinction and highlighting high quality descriptions. In this study, by using of user center, they design commenting intelligence as an approach in proportion to a system development to support comment moderators in identifying high quality comments. Then, they can properly evaluate adaptable and external components of site by use of analytic privilege combination. Proposed system has been evaluated by professional comment moderators who work at national and local news agencies. As this system can be active or transmit journalism experiences about online comments, it presents indications such as applicability and other cases for journalism works in the future [11].

Buhl et al (2016) in an article by the title of " Observing the Dynamics of the Online News Ecosystem: News diffusion processes among German news websites" acknowledge that online news product is determined from report's velocity and changes like contrast of news stream in online news ecosystem. However, these two content are opposite for report, there are few researches about dynamic of news streams in ecosystem level. Considering appllied techniques for automatic analysis of content and large data of online news content, an approach is suggested for performance and dynamic of news diffusion process among online news websites. A few reasoning methods are reviewed for velocity of online news product based on cover of urgent news with high urgency and with imitation from online news presenters. With performance of analytic frame of news events diffusion, repeated dynamics of 95 events diffusion processes are discovered among 28 German online news websites. 3 clusters of diffusion processes are distinguished based on time patterns. On average, it takes only 1.5 hour for the majority of online news sites to report 43 events in the most extensive cluster. There is limited time for communion of news decisions and for ecosystem that reveals a strong potential for sudden wave or explosion in online news streams [12].

Kim et al (2016) in an article by the title of "Sustainability Factors of Emergent Civic News Websites" expressed that local and regional parts of news websites are important for improvement of journalism and progress of societies. In this study, news condition of 4 region by names of Chicago, Seattle, Minneapolis and New York City is considered to describe future structure of local news environment that creates or separates local news websites. This research is based on a qualitative comparative analysis of 137cases that their very important features concerned an institution and place which are related to a news network. In this study, the start-up way and this issue that others can directly note their efforts for increasing their support are suggested [13].

Stephen (2017) in his study evaluates the websites of Ministry of Electronics and Information Technology Organizations in India using the Alexa Internet. The 16 Meity Organizations in India which have the web presence are included in the study. The results of the analysis give interesting insights about the organizations websites. Unique Identification Development Authority of India (UIDAI) is the most popular website and in the first position among the entire organizations website. It holds global rank 572, 29th rank in India. National Informatics Centre (NIC) and Education Research Network (ERNET) websites holds the highest bounce rate of 64.5. UIDAI websites holds the highest links of 1154.Among the Meity autonomous bodies National Institute of Electronics and Information Technology (NIELIT) websites holds first rank and overall NIELIT websites holds second rank[14].

Muthuraja (2018) evaluates the Kannada language newspaper web sites using the most well known tool for evaluating websites "Alexa Internet" a company of Amazon.com. The 10 leading Kannada language newspaper websites from the state of Karnataka were taken for evaluation. Each newspaper web site was searched in Alexa databank and relevant data including traffic rank, pages viewed, speed, links, and bounce percentage, time on site, search percentage, and percentage of Indian/foreign users were collected and these data were tabulated and analyzed. The result of this study shows that Vijayakarnataka has 2,255 the highest traffic rank in India Udayavani has 27,903 the highest traffic rank in global. Vijayakarnataka has 7.32 having highest number of average pages viewed per day and 12:40 estimated daily time spent on site by the visitors[15].

There are many researches about Internet websites quality evaluation, but most of them are about E-government and electronic commercial websites, so news websites have been addressed less than other issues.

By skimming through statistics of accomplished researches number inside and outside of the country about websites quality evaluation, it can be concluded that in our country, most of accomplished researches have been done by using of known and standard models, on the contrary, in the researches about websites quality evaluation out of country, most of them have been without using known and standard models and they have merely focused on an specific criterion. In consideration of literature review of research inside of country and abroad, accomplished researches about websites quality evaluation can be divided into three groups:

First group, are those researches which were insignificant and have studied one or some specific criteria such as efficiency, external attractiveness, reliability, truth, applicability and so on.

About this group's researches, it can be referred to study of Zhang and Tang (2006), Vahid (2008) and Cho et al(2009). Zhang and Tang, in their research, have considered indicators of reliability, responsibility, competence, access, politeness and kindness, relation, validity, security, perception and being concrete from aspects of the electronics portal services quality evaluation.

Second group, are those researchs that evaluate websites by using available general models for all sorts of website. Generally, these models like Web-Qual, WebQEM and so on, have been presented by famous researchers including Dragolatsco and etc. In other words, in this group, it is attempted that only famous models of websites quality assessment were considered on university, company or any other websites.

Third group, are studies which have evaluated a particular spectrum of websites with certain subject. In most of these researches with collaboration of that area's experts and elites, it's attempted to present native models which are proportional to that area in order to these models can be used for that area websites evaluation. That is in third group, it is endeavoured that quality assessment models be separately presented for every certain subject. In this group, most of studies have appertained to evaluation of health, medicine, excursionist, universities and library websites. In this group, there are often specialized models that researchers have presented for evaluation of websites which are in one range. It can be referred to LibQual model for library websites and MusQual for museum websites.

Based on above classification, subject of this research can be put in third group. Regarding present research's topic which is about news websites quality evaluation, there are few researches in this area inside the country and abroad. Researcher has not found any relevant study to news sites quality evaluation inside the country, except two studies including Mirghafoori et al [16] that has designed electronic news websites services quality (E-newsQual) assessment model with factor analysis approach and Sohrabi and Manian [9] that have evaluated quality of most visited news websites in Iran by using combination of TOPSIS and entropy methods.

It is noted that there are not any investigation and research directly about news websites quality evaluation and the researches are often about using current and available models for evaluation of library websites, websites of medical sciences universities, electronic-learning websites and even reservation websites for the world's tourist centers.

3. P RESEARCH METHODOLOGY

Research method is one of the most important parts of a research considering the kind and quality of available data and for access to research purposes.

3.1. Statistical Sample and Population of the Research

Statistical population of this research is generally composed of three main groups: first, the experts of virtual space's area who are mostly professors of universities, research institutes and centers. Second, news websites which are as basic variable of research and third, news sites masters and audiences that are considered by news websites purposes. After determination of statistical population, it should be sampled and determined sample size for generalizability of sample size to population size.

− Ⓚ **Experts:** They have been chosen by Purposive sampling and panellists of Delphi technique are determined by choosing of 18 persons of experts with defined features.

− Ⓚ **News Websites:** according to Alexa ranking site, a list of 500 superior websites in the country are prepared and news websites are sifted through them that among mentioned 500 sites, 69 websites appertain to news websites and news agencies. According to MORGAN

Table, 61 news websites will be chosen among them by random sampling.

− Ⓚ **Masters and Audiences:** News websites always try to gather a list of own visitors' information and specifications for reciprocal relation to it's audiences and visitors. So, in this research, sampling method is convenient sampling. Researcher has attempted to find out websites' audiences opinions by sending questionnaire to audiences of each site.

3.2. Research process

Considering article's topic in this research, it's process is composed of two general parts. In the first part, use of Delphi technique and experts of news industry have resulted in news websites quality evaluation native model. In second part, researcher tries to make intelligent mentioned model based on new idea by using neural networks.
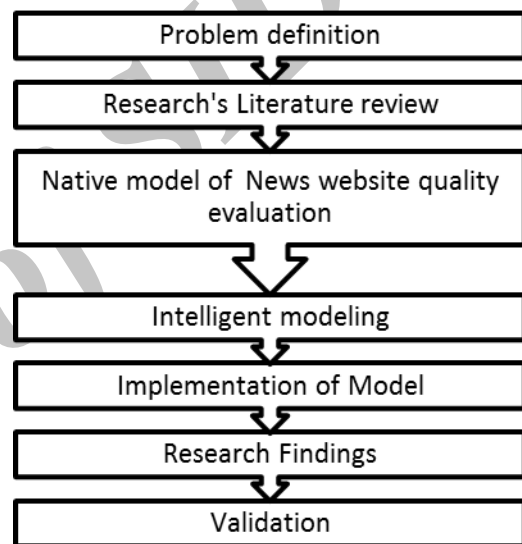

Fig. 1. Research Schematic Model

In first part of research, experts of this area have attempted using of Delphi technique to identify efficacious components and aspects in news websites quality evaluation model. Therefore, in Delphi technique by using research analysis model which is resultant of literature review, a questionnaire is provided and distributed among masters and experts of this area, then it is gathered and analysed.

Three main feature are considered for experts: related education, experience and career experience in area of news site and media management and they should also visit news websites every day for a period of time.

After determination of native model in the first part, news websites quality evaluation intelligent model should be modelled by using artificial neural networks. It is attempted to use two data banks for intelligent model evaluation in order that their accuracy can be assessed and results of intelligent models are compared with each other. The first data bank comprises 61 rows (news websites) and 10 columns (nine-fold indicators+ questionnaire's result)

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and each of the news sites is in one row. The second data bank comprises 994 rows (questionnaire numbers) and 10 columns.

Using above data banks and methods of neural networks' modeling of MLP and neuro-fuzzy, it is attempted to educate artificial neural network. With comparing of mean error of different models' squares, the best model is chosen with least error in ratio to research data.

4. NEWS WEBSITES QUALITY EVALUATION NATIVE MODEL

By literature review, patterns consideration and contrast of them to specifications and features of news websites, the primary model is accessed and it is resulted in a saturation model by executive and experts of university in this area through Delphi survey technique.

Factors and components which are related to each factor are generally shown in Fig.2.

By design of related table, extraction of factors and indicators of available models for sites' evaluation and comparison of them with news websites criterion, following conceptual model is represented:

The mentioned proposed model is produced with compound deductive approach. So the sorts of websites evaluation model that are presented by various researchers, with their indicators and criteria in one table are compared with each other. None of them has particularly dealt with subject of news websites quality evaluation. After completion of related table and adding news sites specifications and features to expressed criteria and indicators of evaluation, efficacious factors and obvious variables can be determined in conceptual model. Each of these factors is separable to other sub-indicators and sub-criteria.

In general, 5 following main factors are identified with different indicators and sub-criteria in news websites quality evaluation:

1. **Technical and Systemic:** This part mostly referred to software, technical and infrastructural subjects.
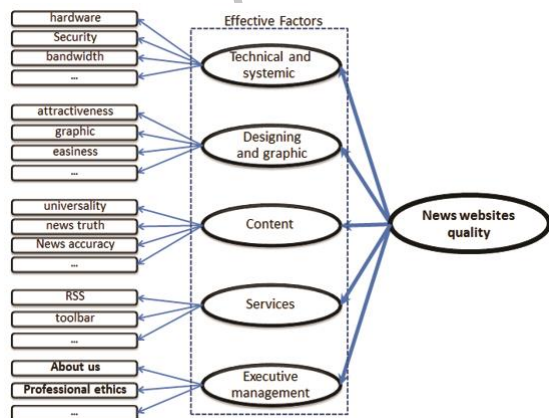

Fig. 2. Research Conceptual Model

Sub-criteria can include subjects of security, access, infrastructure, bandwidth, efficacy and etc.

2. **Design and Graphic Design:** In this part, it mostly deals with website's externals and graphic subjects as user's interface. Including referred indicators in this part can be mentioned attractiveness, graphic, flexibility, easiness, user-friendly and so on.

3. **Content:** Regarding news websites particularities and production and diffusion of news as extract and pivot of such websites, news' features have special importance in the eyes of truth, accuracy and etc. Indicators which are important in this part consist in: news universality, news truth, news accuracy, confidence, reliance and so on.

4. **News Services:** Criterion of news services quality assessment is one of criteria that is less dealt in presented models. Such services are the main particularities and features of news sites and perhaps there is not necessity for existence of such services in SID models and sites. News reader, live coverage, super-keyword, toolbar and etc. are indicators of this criterion.

5. **Executive Management:** This criterion is referred to indicators of management, structure and organization of sites' administrators. For instance, having professional ethics, provincial intermediaries' conditions, inserted information in about yours and extent of acceptability and satisfaction of visitors are news website's suggestions and policy.

General perspective from conceptual model of news website's quality evaluation is observed in Fig.2 and owing to limitation, presentation of components is impossible in this figure.

5. MODELING

Considering research's title, researcher attempts to present an intelligent model based on neural networks technique for news websites quality evaluation. Reason of using neural networks in modeling is least error percent and great flexibility of these networks, in other words, these networks are trained by use of data variations and reform own weight in order that obtained output from these methods be very close to real output with minimum difference.

In this research, for comparison and achieving the better result, two techniques of neuro-fuzzy and feed forward neural network are used and model's data are trained through two mentioned methods in order that best model is chosen by their output contrast.

- *Choosing the kind of neural network and it's Topology*

For choice of neural network that can completely cover needs of this research and provide the best output for

modeling, it should have minimum error in modeling. Therefore, two techniques of feed forward neural networks and neuro-fuzzy network are used and their results are compared with each other.

- *First Technique: Backpropagation neural networks of Multi-Layer perceptron(MLP)*

Cells' relative situation (number, grouping and the kind of their connection) on network is called network Topology. In fact, Topology is system of neurons connection to each other that determines the kind of neural network performance with mathematical method of information process and weight calculation. In this method, Topology of feed forward neural network has been used.

Multi-Layer Perceptron with Back-Propagation teaching algorithm which is one of supervised learning algorithms has comprised two main paths:

- **Forward Path:** In this path, input vector is exerted to neural network and it's efficacy is propagated to output layer through middle layers. For each input, network calculates an amount as output. In this path, network parameters are steady.

- **Backward Path:** After producing output in forward phase, difference of desired (observed) output and calculated output is determined by network. Error signals in backward path from output layer are propagated once more in the whole of network and network parameters are regulated again.
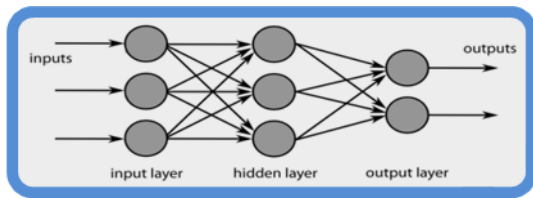

Fig. 3. Topology of Feed Forward Neural Network

Hidden layer(j)   **Output layer (k)**
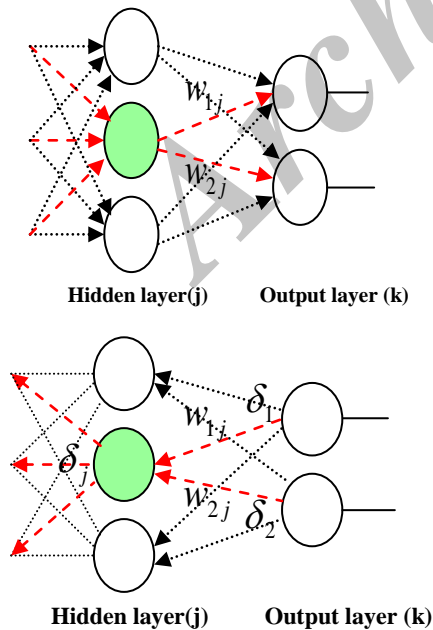

Hidden layer(j)   **Output layer (k)**

Fig. 4. Dual process of Forward and Backward

Above dual process is repeated frequently in order that network output be close to desired output. When obtained error become less than threshold limit value, teaching process will stop.

In order to learning weights of a multi-layer network, Back propagation method is used. In this method, by use of gradient descent, it is attempted that square error of network outputs and objective function of minimum and error are calculated according to the following:

$$E\left(\overrightarrow{W}\right) \equiv \frac{1}{2} \sum_{d \in D} \sum_{k \in outputs} \left(t_{kd} - o_{kd}\right)^2 \qquad (1)$$

T_{kd} and O_{kd} of output and object amount are corresponding to K_{th} output unit and teaching example of d.

Generally, before end, BP algorithm is repeated time after time by use of those teaching data. Different conditions can be applied for end of algorithm: after repetition in determinate times, to become error less than a determined amount, error following special rule.

- *Second Technique: ANFIS Neuro-fuzzy Neural Network*

ANFIS structure has five layers that include input nodes, rule nodes, average nodes, conclusion nodes, and output nodes and they directly relate to each other. Each node has a function with steady and adjustable parameters [17]. Proper structure of ANFIS technique is chosen in proportion to input data, grade of membership, rules and membership functions of output and input. In teaching phase, input amounts will be closer to real amounts by improving grade of membership parameters based on extent of acceptable error.

ANFIS technique uses fuzzy logic and neural network learning algorithms regarding design of antilinear map between space of input and output. It has good capability for teaching, making and classification. It also has this advantage that permits fuzzy rules extraction from numeral information or specialist knowledge and makes a rule-founded in a comparative way. In addition, it can adjust complex change of human intelligence to fuzzy systems [18]. It's learning rule is based on error back-propagation algorithm in view of minimizing error square mean between network output and real output.

Most of fuzzy inference systems include three kinds of Mamdani, Sugeno and Tsukamoto systems that Mamdani system is often used, however, Sugeno system has better performance in calculation and also has certain output [17]. So in this research, modeling is performed according to ANFIS technique by usage of Sugeno system. Desired membership function, among various functions of triangular , trapezoidal , bell, gaussian , Pi, gaussian type 2, and sigmoidal and their proper grade of membership for each input compound are obtained through trial and error test. Also, hybrid learning algorithm which is a combination of error back-propagation algorithm and least squares method, is used for teaching and adaptation to fuzzy inference system.

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Finally, statistical criteria of Mean of Square Error, Modeling Efficiency and Determination Coefficient, which are (2) to (4) relations, are used regarding contrast of different models in each phase.

$$MSE = \frac{\sum\limits_{i=1}^{n} (p_i - o_i)^2}{N} \qquad (2)$$

$$EF = 1 - \frac{\sum\limits_{i=1}^{n} (p_i - o_i)^2}{\sum\limits_{i=1}^{n} (o_i - \bar{o})^2} \qquad (3)$$

$$R^2 = \frac{\left[\sum\limits_{i=1}^{n} (p_i - \bar{p})(o_i - \bar{o})^2 \right]^2}{\sum\limits_{i=1}^{n} (p_i - \bar{p})^2 . \sum\limits_{i=1}^{n} (o_i - \bar{o})^2} \qquad (4)$$

In these relations MSE is Mean of Square Error, EF is indicator of Modeling Efficiency and other indicators mean the following:

R² : Determination Coefficient

P$_i$: Expected amounts by model

O$_i$: Observed (real) amounts

N : Data number in each part of model

P : Mean of expected amounts by model

O : Mean of observed amounts

Therefore, each model which has less MSE amount and also it's modeling efficiency indicator, with variation range from minus infinity to one, and determination coefficient be closer to one, has higher accuracy related to other models[19].

6. NINE-FOLD QUANTITATIVE INDICATORS (NEURAL NETWORK INPUT)

For neural network modeling, numeral quantity of sample sites nine-fold indicators (61 websites) from reference websites are extracted as neural network input. Qualitative score of those sample websites in first part of research is considered as output of model. Nine-fold quantitative indicators and reference websites are separately mentioned in the following:

6.1. Alexa Ranking in the World

Alexa website is used for ranking websites which is based on number of visits. The closer this ranking be to one, the better website ranking is.

6.2. Google PageRank

PageRank is a rate that Google considers for one website from numbers of 0 to 10. However this number be close to 10, it means that website has many inbound links and many websites are linked to it.

6.3. Loading Speed

GTMETRIX website represents each website's complete loading time by calculation of 27 different variables.

6.4. Home Page Link

Moz.com website represents the number of links which are made from other websites on it's main domain.

6.5. Domain Price Estimation

Website domain price is estimated with criteria such as website longevity, backlink numbers and so on.

6.6. SEO Quality

This indicator results from calculation of social media ranking, website applicability, validity of being online, Meta tags, keywords, website speed and etc.

6.7. Website Strength Grade

It results from adding amounts of 4 variables of efficiency, cell phone version, SEO quality and website security for each website.

6.8. Domain Power

It predicts how domain ranking will be on web search engines. Moz company calculates this criterion from combination of most of 40 indicators.

6.9. Efficiency Grade

A score among 0 to 10 is obtained from mean of four parts of access, ability of experience, marketing and technology.

After completion of data table including 10 columns (9 columns of neural network input and one column of neural network output) and normalization of data, network should be designed and it should be taught. For implementation of model, 1170 lines have been programed. Owing to performance of program and possibility of output observation, MATLAB-R2016a software is used.

Two techniques of fuzzy modeling and neural network modeling are applied for program implementation. After implementation of program, considering research data and different proportions of test and teaching data, network is taught in both techniques with various states and conditions and change of related model parameters. Then, regarding least squares error, the best model is chosen.

After network teaching, check of various models, choice of best model for related data, and completion of modeling, it should be able to apply this model for score prediction and finally, modern news websites ranking.

7. FINDINGS

After teaching artificial neural network, various and different modeling ,and comparison of mean of square error of differen fuzzy and neural network models, the best neural network can be chosen for intelligent model of news websites quality evaluation regarding available data.

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TABLE I. COMPARISON OF TWELVE-FOLD NEURAL NETWORKS
MODELS

MSE error	Different conditions	The kind of neural network	Data number
0.063217	5 neuron	Neural modeling	61date (mmm moo each site's questionnaires)
0.14665	10 neuron		
0.028902	15 neuron		
0.16772	3 membership function	Fuzzy modeling	
440.6547	5 membership function		
38.7681	7 membership function		
0.15555	5 neuron	Neural modeling	994 data (websites' questionnaires seqatately)
0.16048	10 neuron		
0.17562	15 neuron		
0.85432	3 membership function	Fuzzy modeling	
0.40802	5 membership function		
0.15611	7 membership function		

As it is obvious on above comparison table, considering mean of square error, it is the best model with minimal error on neural network with three layers which there are 9 input in first layer, 15 neuron in hidden layer, one output in third layer and a data bank including 61 data. It should be mentioned this data bank is the mean of those 994 questionnaires which are completed by experts of this area for 61 news websites. Diagrams and specifications of this model are in the following:
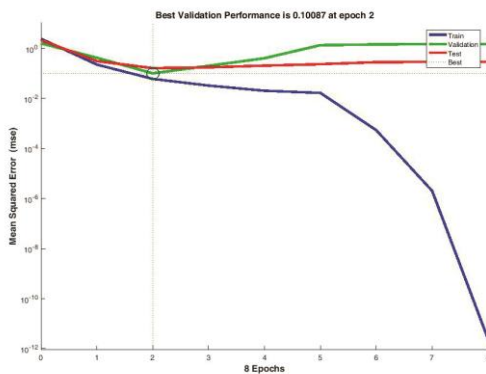

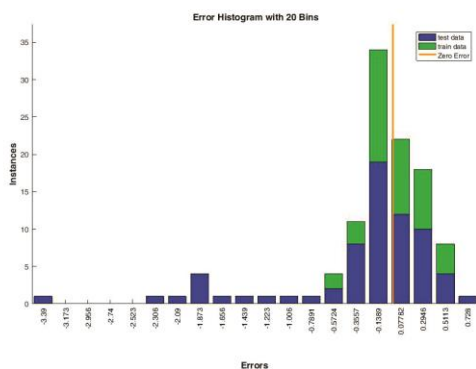Fig. 5. Condition of Teaching Data Progress
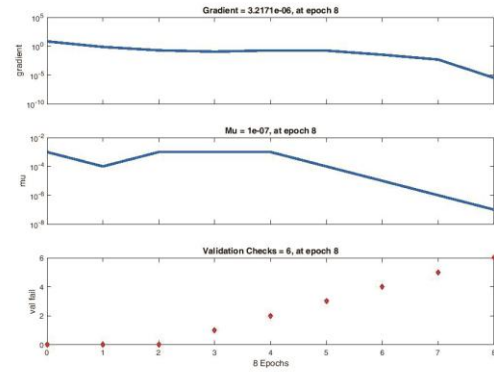

Fig. 6. Error Histogram Diagram

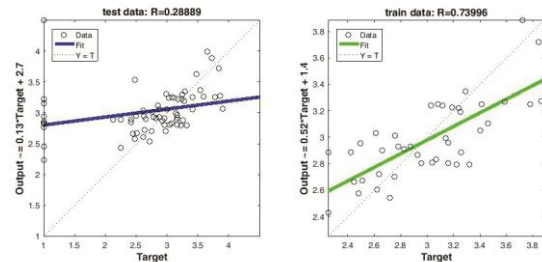Fig. 7. Neural Network Teaching Condition

Fig. 8. Regresion Diagram

8. VALIDATION

The best model with minimum error among predicted models, is on MLP neural network with 15 neuron in hidden layer. For validation and test of this model, 7 modern news websites are chosen randomly with accessibility. These websites are calculated in relation taught model and are ranked considering resultant scores for news sites. Related output are presented on Table II.

As expected, news area experts and specialists acknowledge result and performance of intelligent model when they observed output of news websites quality evaluation intelligent model for seven new chosen news websites and briefly compared them. They believe in designed intelligent model which is high-powered in assessment of news websites quality. It's results are also acceptable and conformable to identified qualitative model in the opinion of experts. As it is obvious, intelligent model of news websites quality assessment evaluates websites without manpower interference. It evaluates websites quality and presents quality score separately for each site, just with choice and entry of website domain in mentioned model. In the end, regarding each website quality score, they will be able to be ranking.

9. CONCLUSION

The quality evaluation of news websites is very vital for the media industry. In the present study, with a combination of quantitative and qualitative research methods and use of the neural network, an intelligent model was produced for quality evaluation of news websites.

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TABLE II. OUTPUT AND INPUT DATA OF INTELLIGENT MODEL

intelligent model's output	News website's domain	News website's name	Rank
3.0207	golestanema.com	Golestane ma	1
2.9486	rahatrack.ir	Rah atrak	2
2.9027	langarkhabar.ir	Langar khabar	3
2.3210	sobheqazvin.ir	Sobhe qazvin	4
2.1376	savalankhabar.ir	Savalan khabar	5
1.8497	8sobh.ir	8sobh	6
1.1044	koodakpress.ir	Koodak press	7

Considering the progress of science and technology, qualitative and quantitative indexes of websites evaluation will always change. To better use the model, we can add other indexes to it in the future and obtain more exact results for news websites quality evaluation.

Idea and initiative of this research, a combination of quantitative and qualitative studies with the use of neural networks, can be used in other works and subjects in virtual space. Also, along with modeling methods, it is possible to utilize a genetic algorithm for optimization of the model in future. With the optimization of the model, we can change each of the indexes and observe their effect on news websites quality concurrently and suggest appropriate methods for related website optimization. Furthermore, we can use other available techniques on neural networks in future investigations and compare their accuracy with this method.

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Hamid Jafary is a PhD student at Allameh Tabataba'i University's Information Technology Department. His main research areas is Data Mining and Artificial Intelligence

Dr. Mohammad Taghi Taghavifard is an Associate Professor in the College of Management and Accounting at Allameh Tabataba'i University (Tehran-Iran). He received his MS in Management Science from University of Tennessee (Knoxville, TN-USA) and his Ph.D. in Industrial Engineering from Wichita State University (Wichita, KS-USA) in 1993. He has published numerous scientific articles in the fields of Industrial Engineering (IE) and Information Technology (IT) and Management of Technology (MT) in several national and international refereed journals and in many conference proceedings. He is also the author of many books in various fields of IE and IT. His research interests include e-government, e-banking, application of IT in management, applications of meta-heuristic methods, and applications of MCDM. He has served as a consultant to many private originations.

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Dr. Payam Hanafizadeh is an Associate Professor of Information Systems and Decision Sciences at Allameh Tabataba'i University (formerly Tehran College of Commerce, 1958), Tehran, Iran. He has held various visiting positions at the University of Waterloo, University of Canberra, Chalmers University of Tech., Masaryk University and Universidad Autónoma de Madrid. He received his BSc., MSc and PhD all in Industrial Engineering and pursues his research in the areas of e-business and decision making under uncertainty. He is the Editor-in-Chief of International Journal of E-Business Research. He has also published over 70 articles for leading journals such as: Internet Research, The Information Society, International Journal of Information Management, Electronic Commerce Research, Energy Policy, Journal of Global Information Management, Telecommunications Policy, Expert Systems with Applications, Systemic Practice and Action Research, Mathematical and Computer Modelling, Management Decisions and Telematics and Informatics to name only a few.

Dr. Abolfazl kazazi is full Professor of Industrial Management at Allameh Tabataba'i University, Tehran, Iran. He received his BSc, MSc and PhD all in Industrial Management and pursues his research in the areas of Production and Quality Management.