ABSTRACT: In the present study, a system is offered, which can recommend news regarding the emotion of users towards the previous news articles the user has searched so far. This recommendation is in a way, which affects the user’s emotion positively. This study reveals that with manipulating the recommendation list we can have a positive impact on the emotion of users. For this purpose, a news application for android devices is developed, which can inform users about daily news and recommend some news to change their emotion toward a positive side. The proposed system is checked in terms of its engine performance and influence on their emotion. To evaluate our system, two groups of people have been chosen which one of them has used the proposed system and the other one has used a simple news application. For a period of more than a month, the emotional impact of the system has been monitored. Investigations and analyses on the users given feedbacks indicate the positive effect of the proposed system on the emotion of users and the alteration of their emotion towards a positive side is 11 times more than a simple news application.

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1. Introduction

With rapid advances of Internet, people show a tendency to fulfill their tasks through the Internet as the time goes by and checking the news is also included. Therefore, news websites are becoming more and more popular through the time [1]. The conducted studies through the recent years have been relevant to the methods by which one can find similarities between the searched news by the user and the new ones broadcasted. To date, the use of emotional data to offer news is unprecedented. By entering such data through the process of recommendation, we can offer news not only adjusted to his interests but also has a positive effect on his emotional state. However, a combination of these systems with emotions and their use for news has other significance. Different sorts of news are spread out each day throughout the world which can have their own effect on the user’s emotion and his emotional health. For instance, the negative state like depression can ease the access to negative information in the mind [2].

In this study, an android application is developed to inves-
igate the impact of recommending news articles to the users based on their emotion toward previous ones that they have read so far. In the evaluation phase, the system was tested with two groups. One group worked with the proposed system and the other group used a simple news application. None of them knew which one of these systems they use. For evaluating, we used a questionnaire that users could reflect their opinions about the systems in them. Based on this questionnaire and also users feedbacks, the impact of our system on users' emotion is measured.

The main contributions in this paper are as follow:

The main purpose of this paper is recommending news to induce positive state in the user’s mind. Hence, it can impress the emotional state of the user. As the emotional health of each person has a direct relationship with the emotional health of the society, the total level of the emotional and mental health within the society are going to be enhanced.

Another positive aspect of this paper is that this is the first study, which has been conducted as a practical experiment to investigate how an emotional news recommender system influences real users.

The other positive point of the present study is the implementation of the offered work in the Persian language. In the Persian language, the structure of some sentences may be changed for example from "Subject+Object+Verb" to "Verb+Object+Subject", making Persian a complex language for automatic NLP works. In addition, to the best of our knowledge, this is the first study has been conducted either in Persian language or in the English language.

This paper is organized as the following: In the second section, an overall review is made on the literature of the study. The third section deals with the introduction of our news recommender system. In the fourth section, the results of the experiments are discussed and the last section is the conclusion of the study.

2. Related work

News recommender systems are usually formed based on three methods: content-based, collaborative and hybrid method. These three methods, together with some other different methods such as determining texts’ classification, form news recommender systems. According to the existing documents, the first generation of such systems appeared in 1994 by GroupLens research association [3]. This system determined those users with similar tastes and interests by employing the collaborative method [4]. However, the separate use of collaborative method brings about some issues in the realm of news, which causes the systems not to be as effective as expected. The first and the most important of them is the fact that it is not possible to suggest an item while it is not searched and seen by a user. Since one of the cornerstones of news systems is their real-time feature – the possibility of suggesting a news exactly when it is uploaded - this is why collaborative systems are facing difficulties in fulfilling their task. The other issue here is that this method cannot put a real and precise difference between users [5].

Regarding the issues with the collaborative method, researchers started using the content-based method. In [6], a news recommender system introduced that it worked based on keeping a record of the pages the user surveys. Then, that news with somehow similar contents with user’s past historical usage was going to be suggested by the system. In this regard, researchers also used different methods to find the probable relevance of news with the history of users’ search. In [7] to determine the similarities between two news, a fuzzy method was used. In the present article, first, the keywords in each news article were singled out from title, body of the text and its category and an evaluation was done based on the location to which any keyword belongs. Then, to determine the similarities, the collected data was exposed to a fuzzy function and the similarity was then evaluated. In [8] an ontology was used to fulfill the task. In the present study which was implemented based on a content-based method, a semantic method was employed to determine the direct and indirect relationships between news articles and subjects of interests induced by the users. Also in [9] an approach was offered to learn users’ interests and tastes. Here the mechanism was dealing with singling out the keywords from the body of the news saved in user’s profile, using the TF-IDF¹ [10] method. Those keywords existing in the text of the news article were added to their mark and otherwise their mark was decreased. Hence, when suggesting, a news item would be recommended that its keywords had a higher mark in user’s profile. The separate use of the content-based method per se has some pitfalls too. One of the problems is that the system would suggest news articles, which are repetitive but written in another style. Meanwhile, this method is merely dealing with user’s profile. Another problem is that sometimes some news articles are bold enough to be informed of, but it is not going to be suggested to the user. For instance, while there are world cup competitions being held there seem to be the necessity of suggesting the related news regardless of the absence of frequency of the related news in user’s profile [11]. To overcome the existing issues researchers have started to employ hybrid methods. In these methods, researchers try to create a profile for the user based on content-based method. In this way, they can suggest news items overlapping with user’s taste. In [6], Google researchers have attempted to change the Google’s news recommender engine, which those days was working based on collaborative method. In this study, regarding the existing issues caused by the separate use of the collaborative method, they have attempted to integrate it with a content-based method to elevate the function and performance of the system. In this system user’s tastes and interests were determined and recognized based on his interactions with the system and
According to them, suggestions were offered to the user. In addition, according to the collaborative method, hot news stories were recognized and by suggesting them to the user tried to predict his tastes change.

Regarding the recommender system evolution, researchers through recent years have sought to use the context data in news recommender systems. In [12] a method was offered in which four dominant features was considered. The total score was calculated based on AHP\(^1\) [13] method and the top-ranked news items were suggested. These features included user profiles, position, ranking and news specification. Users profile included his past historical usage and the main keywords he had searched so far. Position included any context data such as location, weather, emotion etc. Rank referred to the acceptance of the news in general. The news specifications dealt with news reference, time of publication. Ultimately, only one prototype was created based on the locational position, which gave a higher score to the news related to the location where the user lived. In [14] it is mentioned that people in every specific point need some specific reading pattern too. For instance, people usually read economics at work, or they follow sports in café and read entertainment and movies at home. Therefore, researchers tried to determine the reading style of each person in each place and considered the present location of the user in his future suggestions.

To the best of our knowledge, there has been no research conducted based on the emotional data in recommender systems dealing with practical implementation and evaluation of the effect of the system on the users.

3. EmoNews structure

In this paper, a new recommender system is proposed for users to make a positive impact on their emotions. The present section deals with EmoNews, an emotional news recommender system. In Figure 1 the overall scheme of the implemented system is offered. Obviously, in figure 1, the system has two general sections. The first section is responsible for collecting the data and extracting the keywords and the second section deals with doing the calculations to prepare the suggestions and get users' feedbacks.

As you see in Figure 1, this system consists of five main parts:

a) Extractor: Firstly, all different news items are collected through RSS and some lingual processes are done on the titles of each news item simultaneously and then everything is saved in the database.

b) Collaborative filtering procedure: In this section the operation dealing with the collaborative method is done. 

c) Content-based method: This deals with calculation of the content-based method.

d) Monitor: Here, the selected daily news is displayed to the user.

e) Getting Feedback: Finally, the feedbacks are collected to be used in future suggestions.

The reason that EmoNews has several parts is to gain more flexibility, so modifications in a part do not affect

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1 Analytic hierarchy process
of keywords. Others fall into the category of the root of the lexicons in Persian language, through the process of derivation so that the new word has nothing to do with the meaning of a lexicon is to a great extent changed through the lexicon. Sometimes the primitive notion and the root is to delete the additional parts and finds the real root of any word there are two methods [15]: In the first method, a table of words and their roots is used. This table is known as Lookup table. In the second method, by some algorithms, prefixes and suffixes are deleted from the structured words. This stage is called affix remove.

Due to the absence of a reliable resource for determining the root of the lexicons in Persian language, through the present study only the second method has been employed.

Now, to clarify the nature of the extraction phase of keywords an explanation is provided. First, the sentence should be divided into its forming components. From among the separated words, some of them take the role of keywords. Others fall into the category of the prepositions, which are only used to form a meaningful sentence. To determine and delete these unnecessary words a table has been designed with the title of Stoplist in which there is a list of these prepositions. In the proposed model through the process of analysis, any lexical item being included in this list is going to be excluded from the selected words.

To fulfill the task there could be another list, consisting word and verb roots which are derivative and all these could be embedded in a table named Verb. In Figure 2 the method of extracting roots from verbs and words is displayed. For instance, the sentence "خبر آزاد-شنید " is sent to the function. This sentence means “I heard your freedom news” and it consists three keywords, "خبر" "آزاد" "شنید" and one preposition, “را” . First, additional words, "،" are omitted with looking through StopList. Then the sentence is like a fragment "خبر آزاد-شنید" Then, each of these keywords is sent to affix remover function. With omitting affixes, the news is saved in a database like Table 1.

Table 1. The way a news title is saved in database

<table>
<thead>
<tr>
<th>Keyword Id</th>
<th>Keyword</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>خبر-آزاد-شنید</td>
</tr>
</tbody>
</table>

3.2 Collaborative procedure

To implement the collaborative method Mahout Framework has been used. This framework is an environment, which allows developers to build scalable machine learning algorithm [16]. At first, a query should be applied on the entire log data. Therefore, the data that the user has marked as “liked” should be filtered. Mahout starts its work after getting this information. First, it starts finding similar users. For this purpose, the nearest neighbors approach has been employed together with LogLikeHood as a metric function for the purpose of finding those users with a similar history. LogLikeHood considers items as 0 or 1. It means that either a user has searched one item or not [16]. Since by the use of this method items are not ranked and they are only “liked” or “disliked”, this function has been employed to find the similar users. Ultimately, the function can suggest five items, which have more frequencies in users’ search history and it is estimated that the user would like them. The verification process to make sure if the selected items are not among those marked as “disliked” by the user is one of the most important processes of the proposed system. Because disliked news items by the user are filtered through the first stage and are not considered in the rest of the process. However, the items liked by others may be among those disliked by the user.

3.3 Content-based method

In this paper, the content-based method for the proposed system could be done through some stages which are going to be explained. Here, each news article should be checked with the user’s feedbacks. To do so, keywords...
play the dominant role; Keywords selected through the first stage of the process. First, according to the news' type (sport, politics, economics, social) user's feedbacks are filtered. Therefore, they are divided into two categories, like and dislike. Through the next step, each news article should be compared to these two categories and determined it is similar to which groups. Thus, the weight of each word could be determined in news title and then in each of the two mentioned categories. For this purpose, TF-IDF method and vector space model has been employed. In this case, three weight vectors which one belongs to the new news and the other two belong to the feedbacks should exist. Using TF-IDF method, each of the vectors has been initialized in a way that the weight of each word in the new news item can be calculated both in the title itself and in categories (like and dislike) [10], [17]. In Equation 1, it is supposed that vector D includes news titles:

\[ D = \{ d_1, d_2, ..., d_n \} \]  \hspace{1cm} (1)

While T includes all derived original words Equation 2 is:

\[ T = \{ t_1, t_2, ..., t_m \} \]  \hspace{1cm} (2)

Also, Equation 3 shows the vector W in which each element (i.e. each \( w_{ij} \)) stands for weight \( t_i \) in \( d_j \):

\[ W = \{ w_{1j}, w_{2j}, ..., w_{mj} \} \]  \hspace{1cm} (3)
To calculate the weight of each element Equation 4 has been employed. Ultimately the values are normalized by the use of Equation 5.

\[ W = \text{TF}_{ij} \times \text{IDF}_i \] (4)

\[ W_i = \text{tf}_i \times \text{idf} / \sqrt{w_1^2 + w_2^2 + \ldots w_m^2} \] (5)

While \( \text{TF}_{ij} \) and \( \text{IDF}_i \) are defined as Equation 6 and Equation 7.

\[ \text{TF}_{ij} = \text{frequency} \ \left( t_i, d_j \right) \] (6)

\[ \text{IDF}_i = \log \left( \frac{1}{|D|} \sum_{d \in D} \frac{1}{|t_i \in d|} \right) \] (7)

In calculating the feedbacks’ vectors there is no need to calculate the weight of each word separately. Only it is enough to calculate the weight of words embedded in news title. In this case, both the computation elapsed time and the memory usage for calculating the weight of each vector could be decreased.

Through the next step, and after calculating these vectors, by cosine similarity Eq. (8) the similarity of the new news item with each of two other vectors is calculated.

\[ \text{Cos Sim} \ (q, d) = \frac{q \cdot d}{|q| \cdot |d|} \] (8)

In this equation, \( q \) represents one of the two feedback vectors and \( d \) represents the vector of new news. This is repeated for all new news items and similarity between each news article and user’s feedbacks can be calculated.

One of the highly impressive factors in user’s interests is time. As the time goes by, some changes in user’s taste and interests may occur [12]. In the present study, a change course period of one month has been considered. Other feedbacks have been included with a coefficient. This coefficient indicates that new feedbacks are very important. Over the time, the value of feedbacks decreases. The employed coefficient is entitled as validity factor (VF). This is included in [0,1] domain. Every day passed, the value decreases up to 0.033. This has been calculated experimentally and its reason is that the value decreases each day and after a period of a month, the value of VF becomes zero. This value has been allocated to all feedbacks gotten through the day. Therefore, recent feedbacks have a higher value.

After determining and allocating the coefficient, the real value of each weight vectors 'like' and ‘dislike’ is calculated by adding VFs. This value is then multiplied by the cosine similarity to determine the effect of time.

After similarity calculations finished, to have a better view on the calculated values for two groups (like and dislike) a normalization Eq. (9) could be exploited.

\[ \text{Value} = X \cdot \frac{\text{MinValue}}{\text{MaxValue}-\text{Minvalue}} \] (9)

In this relation, \( X \) is the value, which should to be normalized. MinValue and MaxValue are respectively equal to the lowest and highest values in each of two groups “like” and “dislike”. Therefore, all values are included in \([0,1]\) range. Then, news items, which are more similar to “like” feedback category than “dislike” feedback category are going to be selected. After that, five items with the highest similarity could be chosen to be suggested to the user.

3.4 Monitor

In this paper, news articles are divided into four important groups: Politics, social, sports and economics. In each category, there is no difference between daily news and those news items considered as system’s suggestions and their display is in a way that users cannot differentiate between them. News items have been displayed to the user in an order. First, those types of news which are suggested based on collaborative method should be selected and put in the suggestion list. Then those selected by content method could be displayed. Finally, daily news - according to the upload date- can be displayed.

3.5 Getting feedbacks

One of the important parts in a recommender system is receiving the feedbacks from users. With gradual personalization of the user’s profile, recommender systems become more familiarized with the user over time and the precise considerations are going to be more outstanding then. This is due to an increase in the number of the feedbacks the user gives to the system over the time.

As mentioned previously, in this system there are two kinds of feedbacks, like and dislike. These are based on the effect that each news has on the user. Regardless of each user’s taste, each news could have a positive or negative effect on the user. For instance, consider news of an accident. It is probable that the user is interested to read such news. However, this is going to have a negative effect on him. Hence, any user is expected to choose between two options he faces with; "Like and dislike". For each user, there is a distinct and separate profile. Then all feedbacks are followed and saved to be used through the next stages and the function of the system improves over time.

4. Results and discussion

To display the news and test the system, an application has been designed for android devices (version 3 and upper). Android was selected because it is of high popularity these days. It is a simple to use with a high level of functionality application, which has attracted the attention of mobile fans. Too many users are doing their daily affair only by their cellular phones and reading the news is considered to be involved too.

The proposed android application is a simple one and the only task it fulfills is to display the related news to the
user and send the feedbacks to the server. All calculations have been done by the server. When the user selects one news title he is linked to another page to read the full text, based on the effect that it has on the user it is going to be marked as liked or disliked (Like if it has a positive impact and Dislike if it has a negative impact). There is a representation of the related software pages in Figure 3.

In the present study, two tests were applied to assess the system. In the first stage, the system with several users has been tested. This has been done due to evaluate the engine function and to collect data for investigating the evaluation parameters. During this time period, 12 users started working with the system. They were all MSc students; 7 males and 5 females. At first, the application and the way that the users must give their feedbacks were introduced to the users. After that, there were no other controls for the way the users can interact with the application. This has been done in this way because we wanted the users worked with EmoNews like other application on their smartphone.

After a month, the analysis was started. Through a general overview, it was clear that only 5 users had used the application continuously; 3 male and 2 female students. Users’ data was singled out and the efficiency test has been done on this dataset, which was consisting of 938 feedbacks. These feedbacks are obtained through the interaction of these five users with our android application.

To evaluate the efficiency of the recommender system motor, three parameters precision, recall, and F1-score have been used [18]. Precision is the percentage of items, which are suggested correctly (Eq. 1), recall is the percentage of right items that are suggested (Eq. 11) and F1 - score is a precision parameter, which includes both precision and recall that Equation 12 deals with it.

\[
\text{Precision} = \frac{\# \text{tp}}{\# \text{tp} + \# \text{fp}} \quad (10)
\]

\[
\text{Recall} = \frac{\# \text{tp}}{\# \text{tp} + \# \text{fn}} \quad (11)
\]

\[
\text{F1 - score} = \frac{2 \times \text{Precision} \times \text{Recall}}{\text{Precision} + \text{Recall}} \quad (12)
\]

The required values to calculate these three parameters are enlisted in Table 2. To calculate these parameters, all feedbacks of one of the users have been hidden and used them as entering items to the system. Then with a comparison made between the results from the system engine and saved feedbacks these three parameters were collected which are presented in Table 3.

<table>
<thead>
<tr>
<th></th>
<th>Recommended</th>
<th>Not recommended</th>
</tr>
</thead>
<tbody>
<tr>
<td>Used</td>
<td>True Positive(tp)</td>
<td>False - Negative (fn)</td>
</tr>
<tr>
<td>Not used</td>
<td>False-Positive(fp)</td>
<td>True-Negative(tn)</td>
</tr>
</tbody>
</table>

Table 2. Classification of possible result of a recommending of an item [18]

Reasons causing the low rate of social news are perhaps the nature of social news and RSS from which news articles was being retrieved. These sorts of news typically are related to some subjects like murdering, stealing, accident, rape, etc. which have negative effects on the user. Hence, that is the real reason causing the user not to be a diehard fan of such news. This brings about a decrease in the precision on the performance of the system engine.
To start the second phase of the test, the usability test was used. In general, this test deals with representative users in want of doing some representative tasks in a representative field through primary samples of computer interfaces [19].

There are different kinds of usability tests. In a more general word, the term usability engineering is sometimes used for describing any processes or activity with the aim of easing the use by the user. This test falls into three kinds, expert-based testing, automated testing which deals with software and user-based testing. Mostly, when the people are talking about the usability test they mean the user-based usability tests. It means that some representative users are trying to fulfill some representative tasks.

One of the questions in usability tests is the number of the users, which are going to be tested. Some argue that only 5 users could be efficient enough and they can do the task at least up to 80 percent [20]. Accordingly, two groups were selected for the study. The first group consisted of those individuals having interactions with the system for more than a month. This group had 5 study subjects; 3 male and 2 female students. The second group consisted of 7 study subjects of which 5 were female and 2 were male. The first group was reading news offered by our recommender system and the other group was using a simple news application. The subjects of this group were interacting with the system for a week. Neither of the groups was aware of the system and its mechanism. Both groups were following the same instruction. At the final stage, some questions were asked from both groups about the usage manners and the effect of the system. This was done to check the probable effect of the system on the users. In this questionnaire the demographic information is firstly asked from the users, then there are some questions related to the news reading background and using of news recommender systems so far. Finally, some bits of information have been got related to the effect of the application on the users' emotion. The questions of the questionnaire have been divided into three main kinds, which are offered in Table 4.

<table>
<thead>
<tr>
<th>effect of the application on emotion</th>
<th>news reading background</th>
<th>Demographic</th>
</tr>
</thead>
<tbody>
<tr>
<td>Where are your favorites news usually located in the news list?</td>
<td>How much do you follow the daily news?</td>
<td>First name and last name</td>
</tr>
<tr>
<td>How did you feel before reading the news?</td>
<td>How much do you use online news recommender systems?</td>
<td>Age</td>
</tr>
<tr>
<td>How did you feel after reading the news?</td>
<td>What kind of news do you read?</td>
<td>Education</td>
</tr>
</tbody>
</table>

Table 4. A sample of questions in the questionnaire

First, their background of reading news is going to be analyzed. As it is clear in figure 4, both groups are the same in the level of their interests in following news.

Accordingly, it is probable to construe that both groups have the same background and their history and habits have nothing to do with the results. However, this does not really mean that all users have the same taste. Based on the collected information, four users of the first group were familiar with news recommender systems. This is while only three users from the second group had such experience before. Besides, two groups’ tastes towards kinds of news were different too. This is shown in Figure 5. To get the level of their taste and interest in different news categories, users were asked to mark news categories from 1 to 7. 1 is the lowest and 7 is the highest.

Since users were working with the system in their dormitory, there was no limitation for the time and manner of use. Through the rest of the process, the users have been analyzed in terms of their way of use. We wanted the users to use our application the same as the other application on their phone. Therefore, the effect was going to be checked. There was no particular instruction for use. It was revealed that users were working with our application once a day and about 90 percent of them were doing that through the night.

Through the following, based on Figure 6, all users of the first group had a positive feeling after working with the system.

<table>
<thead>
<tr>
<th>Precision</th>
<th>Politic</th>
<th>Economic</th>
<th>social</th>
</tr>
</thead>
<tbody>
<tr>
<td>%66</td>
<td>%80</td>
<td>%40</td>
<td>%20</td>
</tr>
<tr>
<td>Recall</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>%14</td>
<td>%33</td>
<td>%20</td>
<td>%33</td>
</tr>
<tr>
<td>F1 - score</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>%23</td>
<td>%47</td>
<td>%27</td>
<td>%25</td>
</tr>
</tbody>
</table>

Table 3. Evaluation parameters for 4 news categories
In Figure 7, there exists a comparison between the pre and pro use phases of users. Also in Figure 8, a comparison between two groups is indicated.

Obviously, in Figure 8, the first group received more positive emotion and feeling after using the application, something about 1.6 and this is while in the second group this value
As previously mentioned, five items are suggested by the collaborative method and five are suggested by the content-based method to the user. Four out of five users in the first group said that they only surveyed the first 10 news articles and found their choice among them. These were the news suggested by the proposed system about which none of the users had any information. Therefore, it can be construed that the existing positive effect is due to the suggested news by the system and putting them in the list of top ten news has caused such results.

5. Conclusion and Future Work

In this research, a news recommender system has been offered for the first time, which offers suggestions to make a positive influence on the emotion of users based on their emotion toward previous news. This is the most important advantage of this work over existing system. Current news recommendation systems do not consider the effect of their recommendation on users’ emotion. In addition, a case study was conducted on two study groups to check the effect of suggestions on real users. It was innovative work on the language use too because Persian is the language of news articles.

After finishing the implementation phase, two tests have been done on the system. In the first test, the system collected information of the users who were interacting with it during a month. Then the applicability of the recommending engine was checked. In the second test, a scenario was designed. Two test groups were selected. One group was reading news offered by the proposed recommender system and the other group was using a simple application. Neither of the groups was aware of the mechanisms of their systems. Then according to a questionnaire given to the subjects in each group the effect of each system was checked.

Based on the results, the applicability and correctness of the system have been proved and they could be acceptable. Based on the second test, it was clear that recommending news in accordance with their effect on users is...
highly effective on users’ emotion. The achieved results have been demonstrated that the first group, which used the proposed system, received more positive emotion rather than the second group. The difference between the users’ emotion after reading the news and their emotion before reading the news is 1.6, and this value for the second group is 0.142. The positive influence of the proposed system on the emotion of users is 11 times better than the simple news application.

The further possible works in this field would be designing a more advanced system to recognize text's emotion without using the user's feedbacks and it needs richer Persian resources. Another work, which can be done in the future, is to consider synonyms and homonyms to improve the accuracy of the system to find similar news articles.

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