DEVELOPMENT OF A SOFTWARE SYSTEM FOR PREDICTING EMPLOYEE RATINGS

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Abstract. The article deals with the problems of increasing the efficiency of enterprises and developing a system for assessing the rating of employees of an enterprise. Aspects of motivation for compliance with standards by employees and structural divisions are also considered; they were studied because employees are the main driving force of any enterprise. In order to properly evaluate it, many companies need rating systems. In this article, the authors conducted a study and developed a software package for assessing employees of an enterprise. This article describes how to develop a ranking prediction system. MongoDB is used as a database, as the fastest way to innovate, providing the flexibility and ease of use of a database.

Keywords: employee ratings, employee evaluation system, Python, MongoDB

ROZWÓJ OPROGRAMOWANIA DO PRZEWIDYWANIA OCEN PRACOWNIKÓW

Streszczenie. Artykuł dotyczy problemów zwiększania efektywności przedsiębiorstw i opracowania systemu oceny pracowników przedsiębiorstwa. Uwzględniono także aspekty motywacji do przestrzegania standardów przez pracowników i działy organizacyjne; zostały one zbadane, ponieważ pracownicy są główną siłą napędową każdego przedsiębiorstwa. Aby właściwie ją ocenić, wiele firm potrzebuje systemów oceny. W tym artykule autorzy przeprowadzili badanie i opracowali pakiet oprogramowania do oceny pracowników przedsiębiorstwa. W tym artykule opisano, jak opracować system przewidywania rankingu. MongoDB jest używany jako baza danych, jako najszybszy sposób na wprowadzanie innowacji, zapewniając elastyczność i łatwość użytkowania bazy danych.

Słowa kluczowe: oceny pracowników, system ocen pracowników, Python, MongoDB

Introduction

The employee rating system is based on parallel motivation, which provides for giving the personnel management system such characteristics that would allow any employee to apply his abilities in the area in which he is strong and receive satisfaction in all categories of needs. The possibility of this proves once again that the contradictions between hierarchical theories and theories of parallel needs can be removed. Undoubtedly, each employee has his own value system, which determines a unique set and ratio of motivating factors. Therefore, the rating system in the organization should provide employees with the widest and most flexible choice of motivating means, within which each employee who has achieved positive results chooses for himself what has the highest value for him. Rating is always an important assessment of individual skills and qualities. Therefore, it is necessary to develop a digital information system based on new technologies and a rating analysis system capable of determining the progress or regression of a user rating [9].

There is a wealth of research on employee evaluation in terms of performance, leadership, and other quality skills. In an organizational context, performance is usually defined as the degree to which a member of an organization contributes to the achievement of organizational goals [12]. To assess these skills, it is necessary to use tools aimed at providing high-quality feedback about the assessed employee. Because the long-term viability and competitiveness of any organization depend on its ability to evaluate the work of employees and study their contribution to the achievement of goals [10].

There are different approaches to employee evaluation: from traditional to advanced models and methods. This work will focus on using new BigData technologies to create a robust software application and model to provide accurate ranking analysis [7].

MongoDB is used to store module data, which makes it more reliable and efficient in terms of speed and storage. It features high availability, horizontal scaling, and geographic distribution. The MongoDB document model is the fastest way to innovate, providing flexibility and ease of use of the database [5].

If relational databases store rows, then MongoDB stores documents. Unlike strings, documents can store information that is complex in structure. A document can be thought of as a repository of keys and values. The key represents a simple label with which a certain piece of data is associated [4].

1. Stages of creating a rating score

What is the rating assessment of the company's employees, which is compiled to assess compliance with its own corporate standards and which we call "internal rating"? Our definition is as follows: a rating is a single system for assigning points and a method for calculating them in a format that is most convenient for visualization and analysis. A comprehensive rating assessment includes several stages:
- development of a methodology for rating and evaluating issues;
- compiling the questions of the questionnaire;
- preparation of rating forms;
- filling out forms based on the results of the study;
- general analysis (determination of the average level);
- recommendations for individual employees ("work on mistakes").

The basis for the development of the rating methodology is the "mystery shopper" questionnaire, into which selected indicators from the standard are entered. The challenge is to assign weights to different questions. The final rating score is prepared on the basis of fixed standards and non-formalized criteria. When developing a methodology, it should be possible to make subsequent adjustments without losing the original rating data [13].

The development of the rating methodology and the assignment of weights is most often carried out by the company itself, but sometimes external consultants are involved in this, working together with managers. Weighting should be based on qualitative customer research on the importance and perceptions of individual sales and service experiences. It is advisable to compare the obtained data with the results of an expert survey among managers regarding which performance criteria are key and most fully reflect the goals of the organization.

2. User rating analysis. Rating model

Rating is a numeric value representing the employee`s current competence level. It ranges from 0 (lowest value) to 5 (highest value). The rating is a floating-point number (approximation to 2 decimal places).

During each month, the rating of this user will be calculated depending on the following methods of rating assessment [3]:
1. Surveys.
2. Reviews from colleagues.
3. Direct feedback.

A survey is a set of pre-formulated questions created and edited by enterprise managers. All employees of the enterprise at the end of each month participate in a survey where they are asked to evaluate their colleagues. Answer options range from 1 to 5. For example: question 1: "How would you rate the quality of task management of this employee?", response options: "1, 2, 3, 4, 5" (Fig. 1).
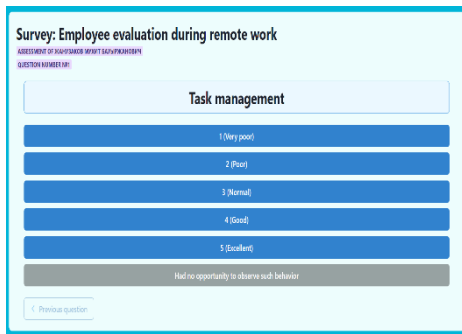

Fig. 1. Survey page

Surveys are optional. Because employees who are forced to take surveys will create biased data as these people usually give unreasonable scores just to complete the survey process as quickly as possible.

The data collected from these surveys will be used to make projections for the future months. That is why it is essential that survey data be as "clean" as possible.

3. Reviews from colleagues

Reviews are the evaluation of an employee in the form of text messages from his colleagues. Feedback can be positive (message type – compliment) or negative (message type – complaint). They are only seen by the managers of the enterprise, because of psychological reasons, as negative feedbacks may affect the employee`s motivation and mental state.

Feedbacks can be anonymous. When negative feedback is created, the system will decrease the current month rating by 10%, otherwise, when it is positive feedback, it will increase it by 15%. Because, positive comments are rarely received and usually harder to get.

If the user`s current rating is "null" (not assessed yet), its rating in case of negative feedback will be 4.5 (10% of 5), and when feedback is positive it will be 5.

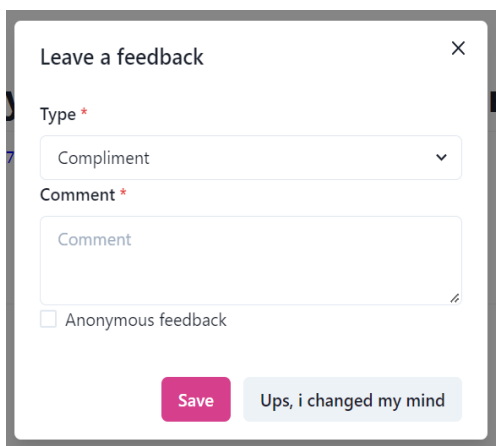User can send feedback by filling up the form in the figure 2.

Fig. 2. Feedback form

The feedback type can be "compliment" or "complaint". The number of compliments and complaints received is also displayed, which will allow HR managers to identify unprofessional and positive employee skills in time (figure 3).
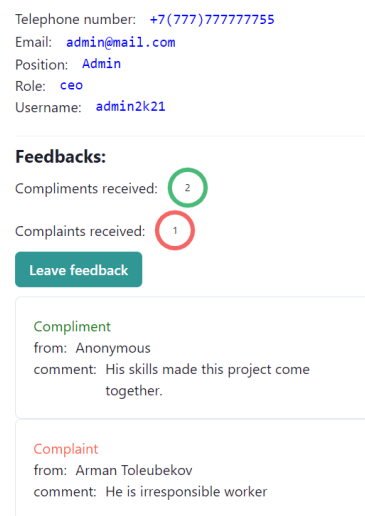

Fig. 3. An employee page with feedback received from colleagues

4. Customers direct assessments

Employees can be assessed directly by anyone, but mostly its clients, by going to the link from generated QR, which is provided after the service or can be obtained directly from the organization itself (figure 4). The link will open up the special form, which will ask the client to assess the current employee`s competence for the provided service from 0 to 5.

Fig. 4. An example of a generated link to a survey page

This value will increase/decrease the current rating by "client Assessment Value" percent. For example, employee`s current value is 3, if the client assessment was 4, then we will increase the current rating by 4%, which is 3.12. However, if the client assessment is below 3, then current rating will be decreased by "client Assessment Value" percent. Let`s say client assessment is 2, then current rating will become 2.94.

If the user`s current rating is "null" (not assessed yet), we will assume that his/her current rating is 1.

5. Development of software application for employee rating analysis

MongoDB Atlas was used as a database for storing ratings and users` data. User`s rating data was stored in "ratings" collections. Rating collection object properties have the following properities [1]:

```
{
    _id: String,
    userId: String,
    createdAt: Date,
    deletedAt: Date,
    data: Array of objects
}
```

Here, the "data" property is an array of individual rating data objects calculated for each month, starting from the month "createdAt" (figure 5).
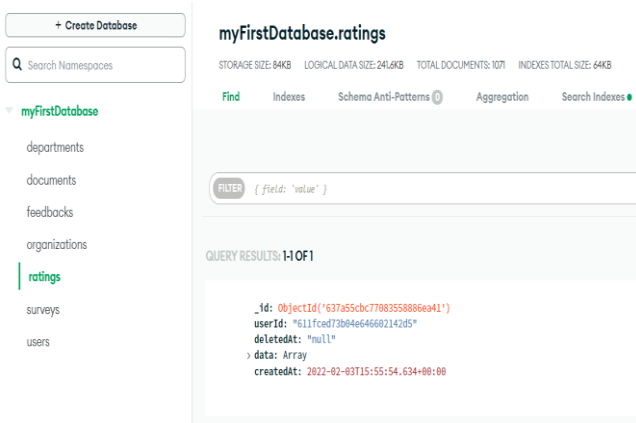

Fig. 5. "Rating" collection

Object "data" contains following props:
```
{
        _id: String,
        date: String in the format "month-year",
        value: Number (Float),
}
```

This data is used to display the rating graph by month. When a new user is created, we create an object in "rating" collection, with the following default values:
```
{
        _id: created automatically by MongoDB,
        userId: id of newly created user,
        createdAt: current date (new Date()),
        deletedAt: null,
        data: [
                {
                        _id: created automatically
                        by mongoDB,
                        date: "01-2022",
                        value: null,
                }
        ]
}
```

6. Information system module architecture

In this work, we have developed a ranking prediction system using machine learning algorithms. In order to use this system to predict users in the system under development, a Python microserver was created.

It receives employee ratings for the current month for each competency from the main web server, passes the data to the employee rating prediction system, and as a result sends the output of the prediction system back to the server (figure 7).

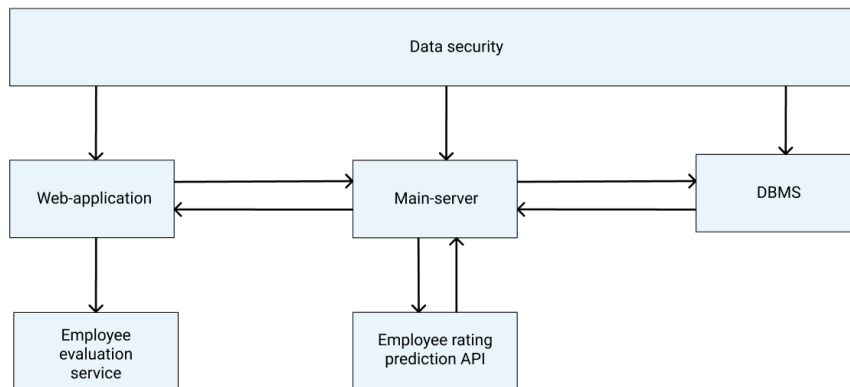Enterprise managers can view the rating reports of employees in a graph (figure 8).

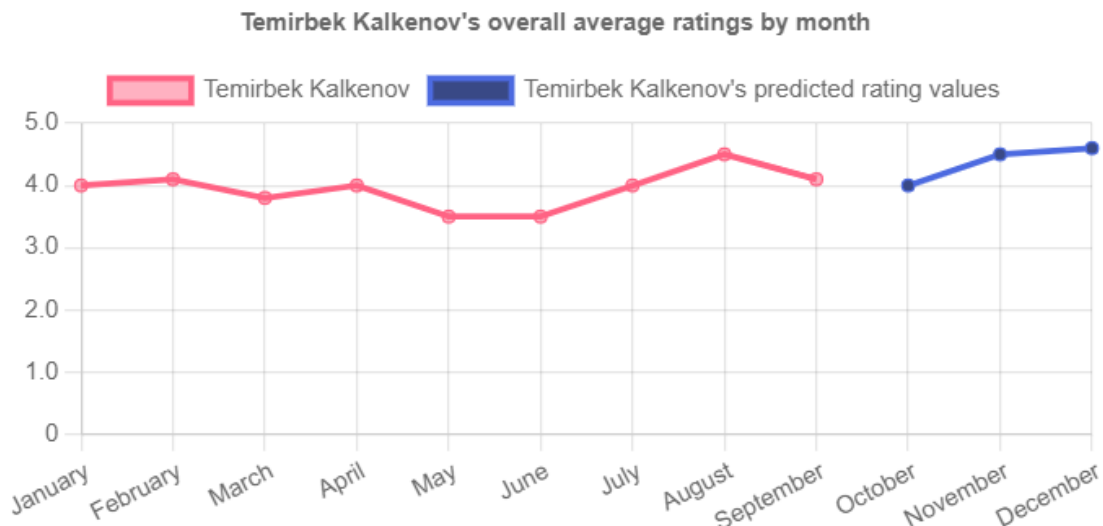Fig. 7. Architecture of the module of the information system for analyzing the rating of employees

Fig. 8. Rating report for 2023 with predictions

7. Conclusion

The main problem of modern enterprises is the quality assessment of employees` productivity and their professional growth. In this thesis, we provide an information system module to solve this issue [11].

This paper described the developed model and software for assessing enterprise employees. The purpose is to create an information system module for employee rating analysis.

Methods for evaluating and predicting the work of employees based on machine learning algorithms have been developed to provide enterprises with a complete rating analysis using modern technologies. An information system for personnel management has been developed using modern software development tools [2]. A model for predicting the rating of employees was built using machine learning algorithms. A software application has been developed for analyzing and predicting the rating of enterprise employees [8].

A collection has been created in the MongoDB database. Rating assessment methods have been developed. An employee rating predicting service was integrated to the software.

Acknowledgments

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