Evaluation Model of Aquaculture Robot Technology Research Project Based on Machine Learning

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Abstract. With the increase of research projects of aquaculture robot technology, how to evaluate the research projects of aquaculture robot technology effectively has become the primary task in the research process. However, in the use of the original evaluation model, the problem of improper selection of the index range often occurred. Therefore, the evaluation model of aquaculture robot technology research project based on machine learning is designed. Obtain the evaluation index of aquaculture robot technology project, calculate the index weight to build the evaluation index system, use machine learning algorithm to complete the collection of evaluation samples, and use the above settings to build the evaluation model of aquaculture robot technology research project. At this point, the evaluation model of the aquaculture robot technology research project based on machine learning has been designed. In order to verify the effect of the design model in this article, design a comparison experiment, evaluate the design model and the original model on a project. It can be seen through comparative experiments, it is known from experimental comparison that this model is better than the original model.

Keywords: Evaluation of scientific research projects · Index system · Machine learning · Keep improve

1 Preface

It is of great significance to improve the efficiency and quality of aquaculture industry to transform the traditional aquaculture industry with modern technology and promote the deep integration of industrialization and informatization into the aquaculture field. Due to the complexity of underwater production environment, research on the application of underwater robots in aquaculture has been paid more and more attention. As a tool for human beings to explore the ocean, underwater robot is a special application of advanced robotic technology in underwater, and is a cutting-edge technology field combining machinery, control, information, navigation, ship and other disciplines [1, 2]. In aquaculture, underwater fishing operation is one of the functional applications of underwater robot. It relies on multi-functional manipulator or straw to catch aquatic
products, which can replace artificial operation in dangerous environment. In order to provide a theoretical basis and comprehensive reference for the development of aquatic robot software, and to have a comprehensive understanding of the scientific research project of aquatic robot technology, this research project was evaluated.

The evaluation of scientific research projects is an important part of scientific and technological management, and its purpose is to achieve the optimal allocation of scientific and technological resources, improve the investment performance of scientific research projects, and make limited funds play a greater role [3]. With the continuous deepening of the reform of the management system of science and technology plans, the role of performance evaluation of scientific research projects has become increasingly important. From the perspective of national science and technology macro policies, the correct evaluation of scientific research project performance can provide the basis for the state to support various disciplines in basic research and provide important references for supporting decision-making in certain fields of high and new technology. From the perspective of local government science and technology guidance, scientific research project performance Evaluation can provide a basis for local governments to support the transformation of high-tech projects or scientific and technological projects suitable for local economic development, so as to strengthen the management of scientific research projects throughout the process and improve the efficiency of scientific and technological plan management. In this research, a corresponding evaluation model will be set to realize the evaluation of aquaculture robot technology research projects.

2 Evaluation Model of Aquaculture Robot Technology Research Project Based on Machine Learning

In the past research, the research project evaluation model of aquaculture robot technology is used to evaluate the research project, but the problem of improper selection of index range often occurs in the selection part of the original model. Therefore, in this paper, machine learning algorithm is used to optimize the original model. The specific optimization structure is as follows (Fig. 1).
Fig. 1. Construction model of aquaculture robot technology research project evaluation model based on machine learning

Through the above process, machine learning and evaluation model are combined to improve the stability of the evaluation model.

2.1 Obtaining Evaluation Indicators for Aquaculture Robot Technology Projects

Underwater robots, also known as unmanned underwater vehicles, can perform certain tasks underwater instead of humans. According to the different communication methods with the surface support system, underwater robots can be divided into two categories: remote-controlled underwater robots and autonomous underwater robots [4, 5]. ROV receives remote control commands and power supply from the surface platform via the “umbilical cord” cable; AUV has power energy and intelligent control system, and it can efficiently complete the predetermined tasks by relying on its independent decision-making and control ability [6]. Worldwide applications of underwater robots have expanded to include cable laying and inspection, seabed mineral survey, salvage
operations, underwater archaeology, aquaculture, water environment monitoring and dam inspection of rivers and reservoirs. The primary problem in establishing the model is to transform the contents that need to be evaluated into relevant indicators according to the basic principles and overall requirements of the evaluation and analysis of scientific research projects. The relevant indicators should reflect the main characteristics of the performance evaluation of scientific research projects, and the research process should focus on the research foundation, research level, research effect and other performance evaluation indicators. According to the principle of analytic hierarchy process (ahp), the performance evaluation model of scientific research projects is an organic series composed of several interrelated, complementary, hierarchical and structural comprehensive indicators. The evaluation indexes of the following scientific research projects are obtained by studying the scientific research projects of aquaculture robots, as shown below (Table 1).

### Table 1. Evaluation index of aquaculture robot technology project

| Number | Index level       | Index content               |
|--------|-------------------|-----------------------------|
| 1      | Project management| Manpower input              |
| 2      |                   | Financial input             |
| 3      |                   | Project preparation         |
| 4      |                   | Facilities condition        |
| 5      |                   | Social environment          |
| 6      |                   | Project management          |
| 7      | Project level     | Technical index             |
| 8      |                   | Application of achievements |
| 9      |                   | Technical service           |
| 10     |                   | Monograph                   |
| 11     |                   | Achievements in scientific research |
| 12     |                   | Intellectual property right |
| 13     |                   | Intellectual property right |
| 14     | Project effectiveness | Market environment      |
| 15     |                   | Input output                |
| 16     |                   | Economic performance        |
| 17     |                   | Social results              |
| 18     |                   | Achievement transfer        |
| 19     |                   | Technology contribution     |
| 20     |                   | Personnel training          |

In the process of collecting the above indicators, it is considered that the aquaculture robot is an application project. Therefore, in the evaluation of applied research projects,
more attention should be paid to its scientific value and social value. At the same time, it should closely integrate the needs of economic and social development. It should be guided by technological advancement and driven by market demand. The following standards need to be covered: innovation, practicality, technical theory, key technology, commonality and core high and new technology, independent intellectual property rights, economic benefits, social benefits, etc.

2.2 Calculation of Index Weight and Construction of Evaluation Index System

In view of the preliminarily constructed evaluation index system, Delphi screening method was adopted to invite experts for several rounds of opinions consultation, and finally the opinions of experts were summarized to obtain the filtered index system [7]. With built in front of the whole process in scientific projects of college and university evaluation index system is relatively large, the space is limited, so this article only discuss the index system of project phases, in the next chapter in the empirical analysis also make this arrangement, at the same time, the selection of cases, in considering the empirical analysis in this section discuss the index system for the commercial development projects.

Set the evaluation index of the past scientific research projects above as the selection range of this evaluation index, and construct a corresponding evaluation index system. Set the index system to \( P \), the evaluation weight to \( X_a \), and the index value to \( Y_i \). Then there are:

\[
P = \sum_{a=1}^{n} X_a \cdot Y_i (a = 1, 2, 3, \ldots, m)
\]

Among them, \( a \) is set as the sequence number of the indicator. Use the above formula to complete the construction of the evaluation index system. This evaluation index system is used as the basis for index selection and weight calculation. In this design, the correlation method is used to assign values to the index weights in the evaluation model, and to set the index system constructed above. Some indicators in the system are set as evaluation influencing factors, and other parts are set as evaluation indicators. Set the evaluation index set to \( G \), and the corresponding reference index set to \( H \), and \( G = \{g_1, g_2, g_3, \ldots, g_m\} \), \( H = \{h_1, h_2, h_3, \ldots, h_m\} \).

The types of scientific research projects based on aquaculture robot technology are more complicated, in order to improve the evaluation accuracy of the evaluation model. For the calculation of indicator weights, a dimensionless process is required. The specific formula is as follows:

\[
\begin{align*}
g'(n) &= \frac{g(n)}{\sum_{m=1}^{j} g(m)/n} \\
h'(n) &= \frac{h(n)}{\sum_{m=1}^{j} h(m)/n}
\end{align*}
\]
In the formula: $n$ represents the number of indicators in the indicator system. $m$ represents the index number, and the above formula is used to calculate the index weight in the system. And reorder the metrics. Due to the large range of indicators, only the weights of indicator types are sorted in this section. The specific results are shown below (Table 2).

**Table 2. Index weight setting**

| Index weight sorting | Index category       | Index specific gravity |
|----------------------|----------------------|------------------------|
| 1                    | Project effectiveness| 35%                    |
| 2                    | Project management   | 35%                    |
| 3                    | Project level        | 30%                    |

Using the above evaluation index weights, complete the evaluation model construction of aquaculture robot technology research projects based on machine learning.

### 2.3 Using Machine Learning Algorithms to Complete Evaluation Sample Collection

The relevant information in the collected project is used as the evaluation data sample. The feature vector [8] of the known sample is $c = \{c_1, c_2, c_3, \ldots, c_n\}$ and the category label is $d = \{d_1, d_2, d_3, \ldots, d_n\}$. According to the Bayesian formula, the conditional probability (post-test probability) that the sample belongs to each class is:

$$T(c|d) = \frac{T(c|d)T(c)}{T(d)} \tag{3}$$

For all classification labels $d_1, d_2, d_3, \ldots, d_n$, $T(d)$ is the same. When comparing $T(c|d)$ and $T(c_n|d)$, you can ignore the $T(d)$ parameter. So the discriminant function of the classifier is:

$$\arg \max T(c_n|d)T(d) \tag{4}$$

Based on the above data, a given data sample is processed, and the sample content is measured to obtain the corresponding sample processing result. Assuming that the sample obeys the Gaussian distribution, the parameters of the prior probability distribution are determined during training, usually using the maximum likelihood estimation, that is, maximizing the log-likelihood function.

To improve the processing effect of sample data, a simple support vector machine linear classifier was created. The optimization goal of the support vector machine is to find a line so that the nearest point to the line can be the farthest. In addition, the points marked in blue are the key support points for fitting the data and are called support vectors [9, 10]. The key factor that the classifier can successfully fit is the position of these support vectors. Data points far from the boundary have no effect on the classifier. Through this section, the classification of scientific research project data and information is achieved.
2.4 Construction of Evaluation Model for Scientific Research Project of Aquaculture Robot Technology

The data processing and index processing of the rating model are completed through the above sections. Using the data obtained above, the construction of an aquaculture robot technology research project evaluation model is completed. The specific process is shown below (Fig. 2).

After calculating the weight of the evaluation index, using the method of weighted function to calculate the index score value of the aquaculture robot technology research project, combined with the evaluation grade table, to complete the construction of the aquaculture robot technology research project.

Considering the counting habit of the percentage system, multiply the weight of each index by 100 to become the standardized value of the evaluation result. The final score of each sub index is:

$$A_n = \sum_{i=1}^{l} E_{om} \chi_{omi}$$  \hspace{1cm} (5)

In the formula: $E_{om}$ represents the $o$-th weight value of the $m$-th sub-indicator, and $\chi_{omi}$ represents the score value of the $i$-th index by the $o$-th expert. $A_n$ represents the quantified score of the calculated $i$-th index. The final score of the comprehensive indicator is:

$$A = \frac{\sum_{i=1}^{l} A_i}{i}$$  \hspace{1cm} (6)
In the formula: \( A \) is the final score. The evaluation grade is established according to the expert score. Combining the above formula with index weight, the corresponding evaluation results are obtained. The results are as follows.

**Table 3.** Classification of evaluation results

| Score  | Scale | Grade  |
|--------|-------|--------|
| [80,100] | I     | Good   |
| [60,80]  | II    | Preferably |
| [40,60]  | III   | Commonly |
| [20,40]  | IV    | Poor   |
| [0,20]   | V     | Difference |

Take Table 3 as the standard and evaluate the pros and cons of the aquaculture robot technology research project according to the score value calculated by Formula 6. At this point, the evaluation model of the aquaculture robot technology research project based on machine learning has been designed.

### 3 Test Experiment

In the above part, the design of the evaluation model of the aquaculture robot technology research project based on machine learning is completed. In order to ensure that the evaluation model designed has high-precision evaluation results, the evaluation effect is tested in the form of experiments.

#### 3.1 Experimental Content

In the process of this experiment, an aquaculture robot research project was selected as the object of this experiment, and the project was evaluated using the design evaluation model and the original evaluation model, and the accuracy of the evaluation results was compared. The selection range of known evaluation indexes directly affects the accuracy of evaluation results. In this experiment, the index selection range of the two evaluation models will be compared to reflect the evaluation accuracy of the model.

During the experiment, part of the calculation process was involved. In order to improve the calculation capacity in the experiment, the equipment used in the set experiment is shown below (Fig. 3).
Fig. 3. Experimental equipment

Use the above experimental equipment to complete the experimental process. In the process of this experiment, the corresponding experimental samples will be set. Through the comparison results between the evaluation index range of the evaluation model and the experimental samples, the differences between the design model and the original model will be obtained.

3.2 Experimental Samples

The design of the experimental process is completed through the above part. In order to improve the reliability of the experimental results, the experimental samples are set as follows (Table 4).

| Experiment sample No | Sample type         | Sample content                                      |
|----------------------|---------------------|-----------------------------------------------------|
| 1                    | Project management  | Manpower input                                     |
| 2                    | Financial input     |                                                     |
| 3                    | Project level       | Technical index                                     |
| 4                    |                     | Application of achievements                        |
| 5                    | Project effectiveness| Achievements in scientific research                |
| 6                    |                     | Intellectual property right                        |
| 7                    |                     | Achievement transfer                               |
| 8                    |                     | Technology contribution                            |

The above experimental sample was used as the control group of this experiment, and the above experimental equipment was used to complete the experimental process and obtain the experimental results. The results of this experiment are presented in the form of a table.
3.3 Experimental Results

With the above settings, the experimental process is completed. The specific experimental results are shown below (Table 5).

| Sample content                      | Does the design model include this index | Whether this indicator is included in the original model |
|-------------------------------------|-----------------------------------------|--------------------------------------------------------|
| Manpower input                     | Y                                       | Y                                                      |
| Financial input                    | Y                                       | N                                                      |
| Technical index                    | Y                                       | N                                                      |
| Application of achievements        | Y                                       | N                                                      |
| Achievements in scientific research| Y                                       | Y                                                      |
| Intellectual property right        | Y                                       | Y                                                      |
| Achievement transfer               | Y                                       | Y                                                      |
| Technology contribution            | Y                                       | Y                                                      |

According to the above experimental results, the index range of the design model in this paper covers the index of experimental samples. The index coverage of the original model does not fully cover the index of experimental samples. Therefore, the index range of the designed evaluation model is larger than that of the original evaluation model. The evaluation precision of the model can be improved by designing this part. The index range of the designed model is of great significance to the evaluation results of scientific research projects.

4 Concluding Remarks

The development of social economy and the need of the development of scientific research projects put forward a strong demand for the evaluation of scientific research activities. Scientific research project is the main form of R & D activities, and project evaluation is the most basic and main form of scientific research evaluation. Compared with general projects, scientific research projects have many special features, such as the difficulty and asymmetry of information collection, the difficulty of process control, and the inconspicuous form of output, which increase the difficulty of evaluation. In this study, machine learning algorithm is used to reduce the difficulty of research on aquaculture robot technology and improve the reliability of evaluation.

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