INFORMATION MEASUREMENT CRITERIA OF THE IMPORTANCE OF RECOGNITION OBJECTS AND THEIR CALCULATION ALGORITHMS

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Annotation
In this work discusses the context and importance of information dimensions of recognition objects. In the process of recognition, criteria such as the originality, accuracy and relevance of the objects are taken into account. These issues are particularly applicable in the fields of medicine and computer vision. On the other hand, the stages of data selection, processing and training in the process of recognition by CNN algorithms were considered.

Keywords: recognition objects, information measurement, computer vision, CNN (Convolutional Neural Network), specificity, accuracy, data processing .

I. Introduction

As a result of the rapid development of modern information technologies, object recognition systems are widely used in various fields. In particular, these systems are gaining importance in many directions, such as security, medicine, industry, and transport. Various practical programs are being created that facilitate human activity, save time and resources through algorithms for correct and effective recognition of objects. This process mainly relies on Computer Vision and Machine Learning algorithms. In particular, Convolutional Neural Network (CNN) algorithms are one of the main technologies widely used in this regard.

Object recognition technologies are of great importance in everyday life. For example, facial recognition algorithms in video surveillance systems serve to increase security measures, while the effectiveness of early detection and treatment of diseases is increasing through medical image processing algorithms. At the same time, in the process of correct identification of objects, the criteria of information measurements are of great importance. Indicators such as object specificity, accuracy, completeness, relevance, and relevance to the context are among the main factors that determine the effectiveness of the system. Especially in the field of medicine, these indicators play an important role in the diagnosis of diseases through images.

II. The main part

The information measure of the importance of recognition objects refers to the quantity and quality of information that can be obtained from or associated with objects in a given context or system. The criteria for evaluating the information content of recognition objects may vary depending on the specific application, but here are the main factors to consider along with explanations: these are uniqueness; importance; compatibility; accuracy; fullness; durability; efficiency; relevance to context; compatibility; privacy and security; scalability; such as adaptability and human understanding.

It can be seen that in solving problems in the field of identification of medical symbols [1, 2, 3, 4, 5] theoretical and practical approaches are described by the authors.

Based on this, recognition objects should be distinguished from each other. This means that they have unique characteristics that set them apart. For example, in a facial recognition system , specificity involves distinguishing one person's face from another based on unique features such as eye shape, nose shape, and so on.

"Specificity in object recognition" can mean distinguishing, recognizing, and receiving information about an object or living object based on its individual characteristics, abilities, structure, and other factors.

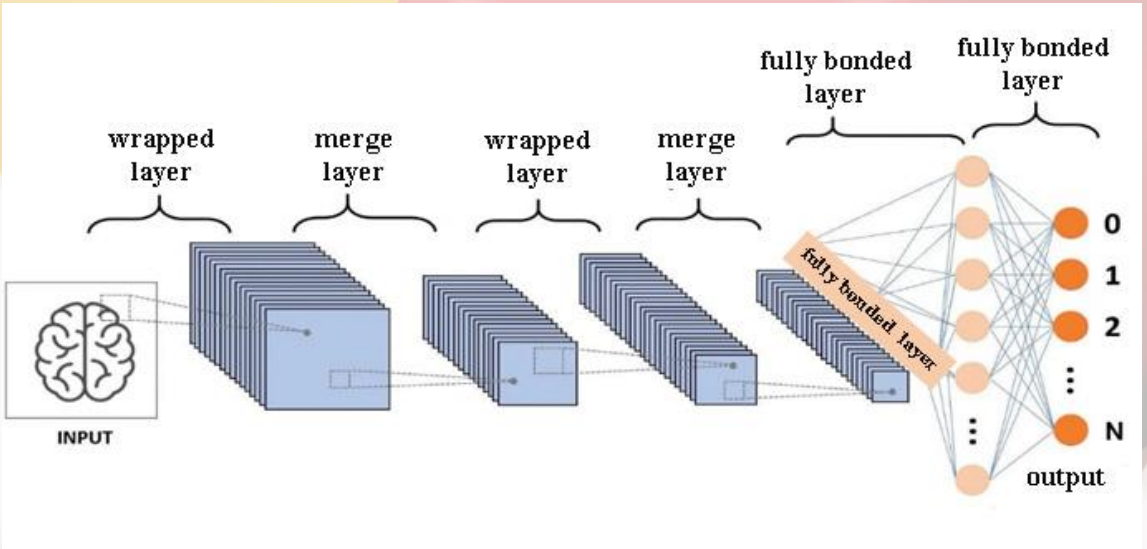
For example, cars can be recognized using special programs (software) according to the instructions. These programs determine the color, type, number and other information of cars. Example: smart cameras in homes. These cameras detect objects (persons, animals, things) in the middle through sound, movement and other sensors. For example, if there is no one at home, but the camera confirms the person, it can send an alarm.

The written program code can also show specificity in object recognition. For example, in text analysis, the program code can recognize words, strings in the text and divide them into categories.

In this research work, it was considered how the criteria of information measurements can be used to improve the efficiency of object recognition systems [6, 7, 8] .

Object recognition is performed using several different technologies and algorithms. Computer vision and machine learning are widely used in this field. The program used to solve problems in this field is the CNN (Convolutional Neural Network) algorithm.
To use the CNN algorithm, the first step is to select images and convert them to the appropriate format. Then, select the data, train the model, and test it.

CNN Algorithm:
Data selection: A data set (dataset) should be selected, for example, CIFAR-10.
Data preprocessing (normalization, augmentation).
Building the model: Next, the model architecture is built.
Training: The model is trained with the data set.
During training, the model is loaded with data and its parameters are changed so that it predicts them correctly.
CNN is the most common type of neural network used in image processing. Image processing in this type of neural networks is done as follows:
1. Images with incoming data are transferred to the convolutional layer.
Here, filtering is done to extract various parameters from the images. In the filtering process, using a matrix of a certain size, which is smaller than the size of the image, it is necessary to move completely through the image and collect new values by multiplying the corresponding elements of the matrix with each other. generation is done;
2. After filtering, the data is passed to the next step, where pooling is performed. The purpose of this was to reduce the size of the image and thereby facilitate its processing;
3. After the images are processed using several layers, which are convoluted and combined, the resulting information is transferred to the fully connected layer. In this layer, the final result problems, such as classification or regression, are solved (see Fig. 1)



1 - picture. CNN is a neural network model

The information associated with recognition objects must be appropriate for the task or context in which they are recognized. For example, in a medical imaging system, relevant information may include the location and size of a tumor rather than unrelated details.

Recognition objects must be consistent in appearance or behavior over time. For example, in video surveillance, person recognition must be consistent across different frames and lighting conditions.

Information obtained from recognition objects must be accurate and reliable. For example, in speech recognition, the system must correctly transcribe spoken words and avoid errors that lead to misinterpretation.

The information content should be comprehensive and cover all relevant aspects of the object of recognition. Completeness means that a product barcode must contain all the necessary information to identify the product, such as the product name, manufacturer and price.

Recognition objects must be able to withstand changes in the environment or noise. For example, in autonomous vehicles, recognition objects such as road signs must be detected, even if they are partially covered or damaged.

Informational content must be communicated effectively without unnecessary redundancy or complexity. For example, effective data compression encoding methods reduce the size of the information content while preserving its essential properties.

The content of the information must take into account the context in which the recognition objects are used. For example, in a recommender system, the system needs to consider the user's preferences and behavior and recommend them contextually appropriate products.

Recognition objects must be designed to work seamlessly with other components or systems. For example, in the Internet of Things ecosystem, devices must use standardized recognition protocols for easy integration.

Information content should be developed with privacy and security in mind. For example, in biometric recognition systems, protecting sensitive personal data is essential to prevent misuse or unauthorized access.

Recognition objects must handle a range of dimensions from small to large. This is especially important in systems such as image recognition, where objects may appear at different sizes or resolutions.

The ability to adapt to changing conditions or new information is essential. In machine learning models, recognition objects must be designed to learn and update their understanding based on new data.

Information content should be presented in a way that people can understand. For example, in data visualization, complex data must be presented in a way that is understandable to users.

Evaluating the information content of recognition objects is critical to the effectiveness and efficiency of a variety of systems and applications, from computer vision and natural language processing to data analysis and decision-making processes. These criteria help design and develop recognition systems to meet specific goals and user needs.

The information content of recognition objects can be quantified using concepts from information theory. In object recognition, information is often measured by the accuracy with which a model can correctly identify objects in images. However, measurement data can be multifaceted and depend on what exactly is being evaluated, such as precision, recall, F1 score, etc.

Here are their mathematical expressions and a few different criteria:

1. Clarity. Accuracy measures the proportion of correctly identified cases among all examples. It is calculated as follows:

$$\text{Accuracy} = \frac{\text{Number of correct predictions}}{\text{Total number of predictions}}$$

2. Clarity. Accuracy is the ratio of true positive identifications among all positive identifications (true positives and false positives). It is calculated as follows:

$$\text{Accuracy} = \frac{\text{Real positives}}{\text{True Positives} + \text{False Positives}}$$

3. Susceptibility (sensitivity). Retention is the ratio of true positive identifications among all true positive cases (true positives and false negatives). It is calculated as follows:

$$\text{To remember} = \frac{\text{Real positives}}{\text{True positives} + \text{false negatives}}$$

4. F1 score. The F1 score is a harmonic mean of precision and recall and strikes a balance between the two. It is calculated as follows:

$$F1\ score = 2 \cdot \frac{Precision + Recall}{Accuracy * Recall}$$

5. Based on the intersection sum (IoU). IoU is commonly used in object recognition to measure the similarity between the common intersection and the underlying set of objects. It is calculated as follows:

$$\text{IoU} = \frac{intersection}{sum}$$

6. Entropy . Information in theory entropy uncertainty or disorder of the amount is the measure of death . The object recognize get for she is objects in classification uncertainty express can It is calculated as follows:

$$H(X) = -\sum_{i=1}^{n} p(x_i)\log_2 p(x_i)$$

Here is $p(x_i)$the probability of the event, $x_i$the observed object.

7. Mutual information. In the context of object recognition, mutual information quantifies the amount of information obtained about one random variable by another random variable between the observed object and the actual object label:

$$I(X;Y) = \sum_{y \in Y} \sum_{x \in X} p(x,y) \log(\frac{p(x,y)}{p(x)p(y)})$$

Here, X and $Y$are random variables representing the observed object and real objects, respectively, $p(x,y)$ and joint.

One or a combination of these metrics can be used to measure information in object recognition.

III. Summary

In this research, the importance of information measurement criteria in object recognition systems, their impact on the efficiency and accuracy of recognition systems was analyzed in depth. Today, object recognition technologies are widely used in various fields, including security, medicine, transportation, and industry.

In the research work, the working process of object recognition technologies based on the Convolutional Neural Network (CNN) algorithm was deeply studied. The CNN algorithm provides effective results in image processing, in particular, in matching their dimensions, filtering images, extracting valuable information, and final classification. Models developed using CNN have the ability to improve their results based on machine learning, making it possible to accurately and reliably classify images. Also, information measurement criteria in object recognition systems, such as accuracy, F1 score, recall, and IoU, are important factors in evaluating the effectiveness of systems. These criteria measure the accuracy, completeness and reliability of object recognition systems. In object recognition systems, indicators are not limited to technological capabilities, but also show how the systems are adapted to human activity.

During the research work, it was confirmed that the role of CNN algorithm and machine learning technologies in the field of object recognition is important. In order to improve the performance of image processing and object detection by the CNN algorithm, it is important to correctly apply the criteria of information measurements. Especially in the training and testing of models used in classification and regression problems, working with datasets and optimizing models helps to achieve efficient results.

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