Image Classification Using Support Vector Machine

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Abstract

The article explains how to classify images using machine learning techniques. The Support Vector Machine with strong flexibility and the capacity to operate with a vast collection of input data was employed to complete this challenge. A software created in the MATLAB simulation environment was used to explain the model. The main difficulty that image classification is gathering a large enough training set of photos to obtain a high probability of successful recognition. The photographs in the CIFAR 100 database, which have a tiny size of 32x32 pixels and are publicly available. It has 60 000 photos organised into ten primary categories. The author's database was then utilised, which included 1000 pedestrians, autos, and road signs.

Introduction

Image classification is a type of image processing technique that uses feature information in photos to distinguish various objects. Image automated categorization technology has been used to numerous spheres of development as a result of the fast advancement of science and technology, as well as people's increasing need for greater quality of life.

The traditional image classification method cannot accurately grasp the internal relationship between the recognition objects when classifying the image, and the traditional method also has the limitation of the recognition object's feature expression due to the too high characteristic dimension of the data, so the experimental results are not ideal.

In light of the foregoing, this research offers a convolutional neural network-based image detection approach. Deep learning and convolutional neural networks are the major components of the experimental approach. The deep convolution neural network model, unlike standard image classification approaches, may be utilised for both feature learning and picture classification at the same time.

Overfitting may be avoided by enhancing the structure of each component of the experiment and optimising the convolution neural network model, and therefore the accuracy of image identification can be increased. The experiment using the cifar-10 database reveals that the method's upgraded deep learning model achieves effective picture detection results.

Without engaging any human assistance at any stage, picture recognition is an essential aspect of image processing for machine learning.

We look into how picture categorization is done using an imagery backend in this research. Thousands of photographs of cats and dogs are captured and then divided into two categories for our learning model: test dataset and training dataset. The findings were produced using a bespoke neural network with Convolution Neural Networks architecture and Keras API.

The topic of using artificial intelligence in circumstances where it is hard to precisely categorise data is gaining traction these days. Smartphones, self-driving cars, and translational tools all employ artificial neural networks (ANNN). They can deal with challenges requiring highly precise categorization thanks to their capacity to learn, which is based on looking for similarities between objects and generalisation.

Machine learning is a scientific computer field that uses a set of observed instances to automatically learn to understand complicated patterns and make intelligent conclusions (training data). The Support Vector Machine (SVM) is a classification approach that uses supervised machine learning. To discover the largest margin between the classes, an SVM kernel-based approach creates a model for translating a low-dimensional feature space into a high-dimensional feature space.

We studied the efficacy of utilising machine learning algorithms for defect picture classification with the support of a prominent firm in visual inspection of film flaws. We also used the GPU to speed up both image processing and machine learning for flaw identification. For visual classification of film faults, we suggest combining deep neural networks with a random forest classifier, which performed better than either strategy alone.

Literature Survey

The identification of materials present in urban environments is becoming more precise with the arrival of orbital and aerial photographs with extremely high spatial and spectral resolution. As a consequence, we investigate many techniques in depth in order to discover the algorithm that produces the best results in the characterisation of urban objects.

The hyper spectral picture utilised in this study depicts an area over Houston University and its environs, with 48 spectral bands, a spatial resolution of 1 metre, and a spectral range of 380 nm to 1050 nm.

Feature extraction was completed to increase classification accuracy. We employed procedures such as the Normalized Difference Vegetation Index (NDVI), Minimum Noise Fraction (MNF), Principal Component Analysis (PCA), and Soil Adjusted Vegetation Index (SAVI) accessible in particular software to produce such early results (SAVI). Multiresolution Segmentation and Spectral Difference were used for picture segmentation. Form and compactness criteria are required for multi-resolution segmentation.

It is challenging to classify objects/features from underwater photos due to the insufficient datasets. In order to address this, this article uses a machine learning-based Bag of Features model. The data was collected using a remotely operated vehicle (ROV) in shallow water.

Because the categorization of features in underwater optical pictures is challenging due to the low light intensity, the SURF (Speeded-Up Robust Features) and SVM (Support Vector Machines) methods are used in the Bag of Features model to achieve maximum accuracy. Better results are obtained by evaluating the performance of training and testing datasets.

Early detection of glaucoma is advantageous for improved eyesight. The clinical tools that are now available are non-automated and operate on a manual basis. In this paper, we present an SVM for glaucoma classification using a machine-learning framework's supervised method. For fundus picture extraction in this investigation, a 2-dimensional variational mode decomposition method was used.

The high-frequency modes were then used to construct texture-based characteristics such the Zernike moment, chip histogram, and heralic features. One of the goals of hyper spectral remote sensing is to use the spectral behaviour of each item in different parts of the electromagnetic spectrum to discriminate and identify the materials on the Earth's surface.

Different image classification techniques may be used to accomplish such separation and identification. There is no such thing as a flawless classifier, because every algorithm contains labelling mistakes. The identification of materials present in urban environments is becoming more precise with the arrival of orbital and aerial photographs with very high spatial and spectral resolution.

The research looks at the prospects for utilising machine learning approaches in the categorization of thermographic pictures for technical diagnostics. A software has been created to extract the statistical properties of thermographic pictures. A machine learning model has been created and tested for categorization of thermographic pictures of induction motors.

Methodology

Before applying machine learning techniques to utilise the SVM as a model, it is important to correctly process the picture, which may be separated into different steps. Segmentation is the initial step in the machine learning process for Image classification. The picture is broken into sections that are connected in some way.

This is used to separate sections that belong to a certain item, its borders, shape, or reduce the amount of unneeded data sent to the next step in the computer memory. The next step is visual feature analysis, which allows you to disclose and explain item attributes that might otherwise go unnoticed using only your eyes.

Given the high complexity of the physical processes (mathematical models) arising from the imaging of thermographic images on the one hand, and the large number of operational and human factors influencing measurement results on the other, it is clear that using the traditional programming approach to compile mathematical models and algorithms for image classification is impractical.

The processing of thermographic pictures was accomplished using a programme written in the Matlab R2019b software environment. The application accepts pictures with various pseudo-color representations of the thermal field or CSV files containing matrix as input data. The supplied data is transformed to a grayscale picture regardless of the kind.

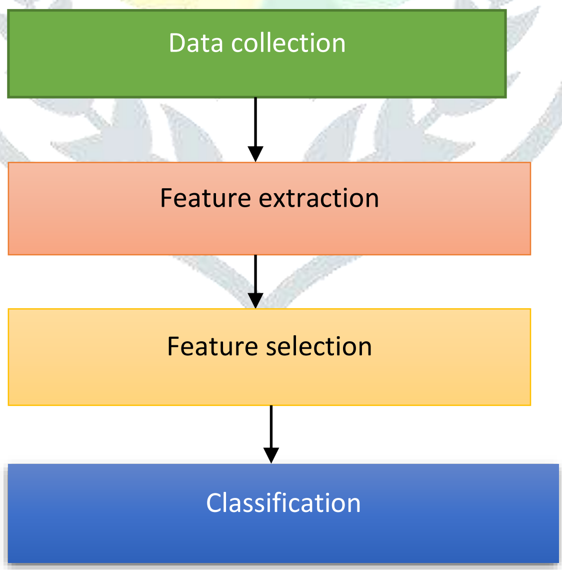

Fig 1. Flow of the work

Result and discussion

A classification of the same set of sixty test photographs was used to compare the two models' performance. The test set includes 40 photographs of operable motors, ten images of motors with venting issues, and ten images of motors with bearing difficulties. When the test picture set was processed using the SVM classification model, the outcome was 50 photos rated as serviceable (good), 13 images classified as bearing fault, and 2 images classed as a ventilation problem. The SVM model's relative error in predicting the state of the motors is 32.34 percent.

True class

Predicted class

Fig.2 Confusion matrix

Conclusion

The use of machine learning techniques in the processing and categorization of pictures greatly speeds up these procedures, reducing their length and manpower consumption. Other types of electrical equipment can benefit from the suggested image processing methods and categorization model. All that is required is for the defect detection model to be retrained. By assessing the significance of individual statistical features and lowering the number of input factors, the accuracy of prediction of the considered technical states may be improved.

References

1. Y. Olivatti, C. Penteado, B. P. T. Aquino Jr, R. Maia, Analysis of artificial intelligence techniques applied to thermographic inspection for automatic detection of electrical problems, 2018 IEEE International Smart Cities Conference (ISC2), 2018, DOI: 10.1109/ISC2.2018.8656724.
2. Z. Jia, Z. Liu, C. Vong, M. Pecht, A Rotating Machinery Fault Diagnosis Method Based on Feature Learning of Thermal Images, IEEE Access Vol. 7, pp 12348-12359, 2019, DOI: 10.1109/ACCESS.2019.2893331.
3. M. S. Jadin, K. H. Ghazali, S. Taib, Thermal condition monitoring of electrical installations based on infrared image analysis, 2013 Saudi International Electronics, Communications and Photonics Conference, 2013, DOI 10.1109/SIECPC.2013.6550790.
4. A.S.N. Huda, S. Taib, Suitable features selection for monitoring thermal condition of electrical equipment using infrared thermography, Infrared Physics & Technology vol. 61, 2013, pp 184-191, DOI 10.1016/j.infrared.2013.04.012.
5. Z. Hui, H. Fuzhen, An Intelligent Fault Diagnosis Method for Electrical Equipment Using Infrared Images, Proceedings of the 34th Chinese Control Conference, 2015.
6. Y. Lozanov, S. Tzvetkova, A methodology for processing of thermographic images for diagnostics of electrical equipment, 2019 11th Electrical Engineering Faculty Conference (BulEF).

7. Ullah, F. Yang, R. Khan, L. Liu, H. Yang, B. Gao, Predictive Maintenance of Power Substation Equipment by Infrared Thermography Using a Machine-Learning Approach, Energies 2017, 10, 1987; doi:10.3390/en10121
8. Chen, S.; Wang, H.; Xu, F. and Jin, Y.Q., “Target Classification Using the Deep Convolutional Networks for SAR Images,” IEEE Transactions on Geoscience and Remote Sensing, 54 4806 –4817 (2016). https://doi.org/10.1109/TGRS.2016.2551720
9. Ciresan D. C., Meier U., and Schmidhuber J., “Multi-column Deep Neural Networks for Image Classification,” in IEEE Conf. on Computer Vision and Pattern Recognition CVPR, (2012). https://doi.org/10.1109/CVPR.2012.6248110
10. Hryvachevskyi, A., Prudyus, I., Lazko, L. and Fabirovskyy, S., “Improvement of segmentation quality of multispectral images by increasing resolution,” in 2nd International Conference on Information and Telecommunication Technologies and Radio Electronics, UkrMiCo 2017 - Proceedings 8095371, (2017). https://doi.org/10.1109/UkrMiCo.2017.8095371