ISSN: 2321-7782 (Online)
Volume 2, Issue 3, March 2014
International Journal of Advance Research in Computer Science and Management Studies
Research Article / Paper / Case Study
Available online at: www.ijarcsms.com

Differential Evolution algorithm with Support Vector Machine to classify objects efficiently

Sharmishta Desai[1]
Research Student
Computer Engineering Department
VIT, Pune University
Pune – India

Dr. S. T. Patil[2]
Professor
Computer Engineering Department
VIT, Pune University
Pune – India

Abstract: ***This paper explains a method of classifying objects efficiently using optimized search space. Automatic detection and classification of objects is required in many applications like automatic selling of goods, vending machines etc. These applications require extracting monetary characteristics from an object image. To detect and classify objects, many classification algorithms are available. Support vector machines are an effective tool used for accurate classification and detection of objects. Instead of searching objects in whole search space differential evolution algorithm is used to reduce the search space .In this paper, advantages of using differential algorithm and support vector machines instead of using other optimization and classification techniques is explained herewith.***

Keywords: SVM, DE, Counterfeit Objects, Optimization, Classification, Neural Network, Kernel function.

I. INTRODUCTION

With the advance of digital imaging technologies, colour scanners and laser printers make it increasingly easier to produce counterfeit objects with high resolution. The proliferation of Counterfeit objects in circulation leads to profit loss of traders and business. Therefore, finding an efficient method to detect counterfeit objects is an imperative and demanding task for business transactions in our daily life. Automatic methods for object recognition are required in many applications such as automatic selling-goods and vending machines. Extracting sufficient monetary characteristics from the object image is essential for accuracy and robustness of the automated system. This is a challenging issue to system designer. Classification problems becoming extremely important in decision science. Differential evolution (DE) is a method that optimizes a problem by iteratively trying to improve a candidate solution with regard to a given measure of quality. Such methods are commonly known as metaheuristics as they make few or no assumptions about the problem being optimized and can search very large spaces of candidate solutions.

In this paper, Section II covers work done by different authors in literature. Section III explains proposed method with explanation of support vector machine and differential evolution algorithm. Section IV gives advantages of applying SVM and DE to classification and optimization objects. Section V concludes the paper.

II. LITERATURE SURVEY

The Turkish Lira and Cyprus Pound et al explained the implementation of a single NN to classify objects. In this paper, author has implemented back propagation Neural network using an input layer with 100 neurons, one hidden layer with 30 neurons and one combined output layer with nine neurons. But the neural network requires sufficient amount of training data. As data increases, the number of neurons increases and number of layers also increases with this. It takes more execution time. Hamid Hassanpour , Payam M. Farahabadi et al.[2] explained using Hidden Markov Models for paper currency recognition. Hidden markov model is recursive algorithm so it expensive in terms of memory and time. Fumiaki Takeda, S. Omatu et al. [1] explained A neuro-paper currency recognition method using optimized masks by genetic algorithm. Masks are used for Paper

currency recognition. The authors regard the position of the masked part as a gene. The authors sample the parental masks and operate "crossover", "selection", and "mutation" to some genes. Genetic algorithms are simple but they cannot be applied to real valued data like noisy or multidimensional data. K.I. Kim et.al.[6] explained Support vector machines for texture classification. Support vector machines (SVMs) have been shown to be an effective tool for solving classification problems [4]. The practitioner has to determine the kernel function and the associated kernel hyper parameters in advance. Unsuitably chosen kernel functions or hyper parameters may lead to significantly bad performance.

III. PROPOSED METHOD

Combining Differential evolution algorithm with support vector machines provides us optimization of candidate solution and accurate classification of objects.

A. Differential Evolution Algorithm

The differential evolution algorithm is proposed by storn and price. It is optimization algorithm used to optimize a search space. The method of differential evolution's functioning is similar to genetic algorithm's approach and is summarized in the Pseudo code below.

Begin
Generate randomly an initial population of solutions.
Calculate the fitness of the initial population.
Repeat
For each parent, select three solutions at random.
Create one offspring using the DE operators.
Do this a number of times equal to the population size.
For each member of the next generation
If offspring(x) is more fit than parent(x)
Parent(x) is replaced.
Until a stop condition is satisfied.
End.

Differential Evolution like the method of Genetic Algorithms allows each successive generation of solutions to 'evolve' from the previous generations strengths. The method of differential evolution can be applied to real-valued problems over a continuous space with much more ease than a genetic algorithm. The idea behind the method of differential evolution is that the difference between two vectors yields a difference vector which can be used with a scaling factor to traverse the search space.

B. Support Vector Machine

Support Vector Machines are based on the concept of decision planes that define decision boundaries. A decision plane is one that separates between a set of objects having different class memberships[4]. An example is shown below. Suppose we want to classify a company whether it is solvent or insolvent. For this SVM need to consider the financial ratios of this company. xj = (xj1, xj2, …xjd), where xj is a vector with d financial ratios and xjk is the value of the financial ratio number k for company j, k=1,…,d. So zj , the score of company j, can be expressed as:

$$Zj=W1Xj1+W2Xj2+\ldots\ldots+WdXjd+b \quad (1)$$

In a compact form:

$$Zj=XjTw+b \quad (2)$$

Where w is a vector which contains the weights of the d financial ratios and b is a constant. For Classification SVM need to decide values of w and b using training sample. From geometric view finding values of w and b is nothing but looking for a hyper plane which best separates training samples into two classes. The line which passes through the middle of hyper plane has equation xTw+b=0.It is shown below in figure.

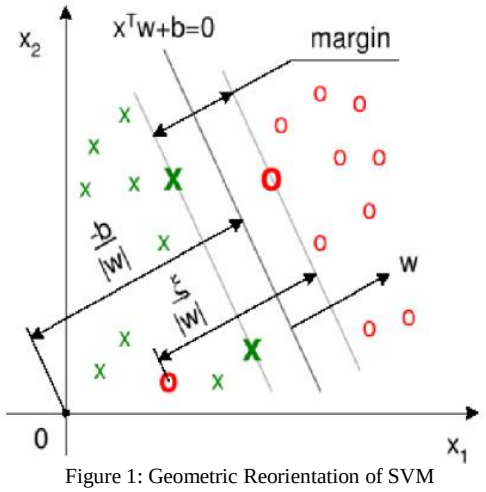

Figure 1: Geometric Reorientation of SVM

The misclassified sample is represented by using slack variable ξ. If ξi=0, then the object is i classified accurately. Positive value of slack variable indicates incorrect classification of objects.

To represent high dimensional data using SVM kernel functions are introduced [9]. Using kernel functions image data is converted into Euclidean feature space so that the nonlinear data looks like linear data [9]. It is shown below.

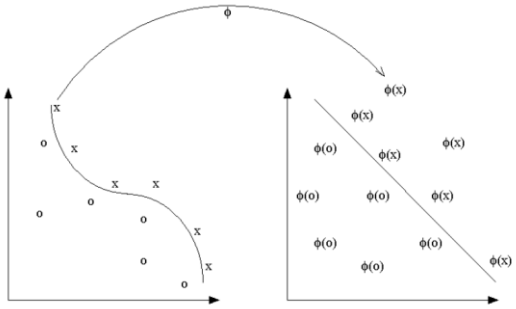

Figure 2: Kernel Method Embedding

The function φ embeds the data into a feature space where the non-linear pattern now appears linear. The kernel computes inner products in the feature space directly from the inputs.

$K(x,z)=< \varphi(x), \varphi(z)>$

IV. ADVANTAGES

- Objects are accurately classified using SVM algorithm.
- By introducing the kernel, SVMs gain flexibility in the choice of the form of the threshold separating objects.
- Data needs not be linear and even needs not have the same functional form for all data, since its function is non-parametric and operates locally.
- SVMs deliver a unique solution. This is an advantage compared to Neural Networks, which have multiple solutions and for this reason may not be robust over different samples.
- With the choice of an appropriate kernel one can put more stress on the similarity between objects, because the more similar the structure of two objects is, the higher is the value of the kernel.
- Optimization of search space is achieved by using DE algorithm.
- The biggest advantage of the differential evolution approach over the genetic algorithm approach is its stability.
- The greatest setback for genetic algorithm's approach is problems with premature convergence.

V. CONCLUSION

Stability and mature convergence of differential evolution algorithm is combined with accurate classification of SVM to classify object accurately. SVM is preferred over other classification techniques due to its nonlinear data consideration. Differential Evolution algorithms are preferred over GA due to their stable behaviour .SVMs can produce accurate and robust classification results on a sound theoretical basis, even when input data are non-monotone and non-linearly separable. So they can help to evaluate more relevant information in a convenient way. Since they linearize data on an implicit basis by means of kernel transformation, the accuracy of results does not rely on the quality of human expertise judgement for the optimal choice of the linearization function of non-linear input data.

References

1. F. Takeda, T. Nishikage, S. Omatu, Banknote recognition by means of optimized masks, neural networks and genetic algorithms, Engineering Applications of Artificial Intelligence 12 (2) (1999) 175–184.
2. Hamid Hassanpour , Payam M. Farahabadi,using Hidden Markov Models for paper currency recognition, Expert Systems with Applications,2009
3. The Turkish Lira ,Cyprus ,the implementation of a single NN to classify objects
4. Chi-Yuan Yeh, Wen-Pin Su, Shie-Jue Lee, Employing multiple-kernel support vector machines for counterfeit banknote recognition, Applied Soft Computing,2010
5. A. Frosini, M. Gori, P. Priami, A neural network-based model for paper currency recognition and verification, IEEE Transactions on Neural Networks 7 (6) (1996)1482–1490.
6. K.I. Kim, K. Jung, S.H. Park, H.J. Kim, Support vector machines for texture classification,IEEE Transactions on Pattern Analysis and Machine Intelligence 24(11) (2002) 1542–1550
7. C. He, M. Girolami, G. Ross, Employing optimized combinations of one-class classifiers for automated currency validation, Pattern Recognition 37 (6) (2004) 1085–1096.
8.] M. Ionescu, A. Ralusce, Fuzzy hamming distance based banknote validator, in:Proceedings of the 14th IEEE International Conference on Fuzzy Systems, 2005,pp. 300–305.
9. C. Cortes, V. Vapnik, Support-vector network, Machine Learning 20 (3) (1995) 273–297.

AUTHOR(S) PROFILE

Sharmishta Desai has completed her graduation from Shivaji University in 2003 under and post-graduation from University of Pune in 2011. She is currently pursuing her Ph.D. in Computer Science and Engineering from VIT, Pune University. Her research areas include machine learning, Image Processing and, Information Security. She has published about 19 papers on topics related to her areas of interest. She has written two books of object oriented programming.

