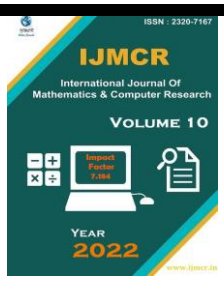
International Journal of Mathematics and Computer Research

ISSN: 2320-7167

Volume 10 Issue 06 June 2022, Page no. – 2701-2704

Index Copernicus ICV: 57.55, Impact Factor: 7.362

DOI: 10.47191/ijmcr/v10i6.01



Performance Evaluation of Genetic Algorithm Selection Methods in Outlier Detection: Further Analysis

EFUNBOADE, Ayodeji Oyeyinka[1], OYENIRAN Olubunmi Rotimi[2], ODENIYI Olufemi Ayodeji[3]

[1]Department of Computer Science, Osun State College of Technology, Esa-Oke, Osun State, Nigeria

[2]Department of Electrical / Electronics Engineering, Osun State College of Technology, Esa-Oke, Osun State, Nigeria

[3]Department of Computer Science, Osun State College of Technology, Esa-Oke, Osun State, Nigeria

ARTICLE INFO

Published Online:
01 June 2022

Corresponding Author:
Efunboade, Ayodeji Oyeyinka

ABSTRACT

Feature selection is very crucial in the activities of soft computing algorithms for quality, precision and accuracy. This paper evaluates the performance of some feature selection methods of Genetic Algorithm in outlier detection on fingerprint images. Roulette wheel, Rank and Tournament methods were considered for feature selection and selected features were enhanced using histogram equalization. K-nearest neighbor algorithm was employed for classification to detect outliers. The implementation of the experiment was carried out in Matrix laboratory environment. Performance of the selection methods were evaluated based on metrics of accuracy, specificity, precision and computation time.

KEYWORDS: Feature selection, Roulette wheel, Rank, Tournament, Genetic algorithm, outlier detection

I. INTRODUCTION

Genetic Algorithm (GA) is a search and optimization technique that belongs to the evolutionary algorithms class and its development was inspired through the process of natural genetic evolution. [1] Genetic Algorithms are optimization search algorithms that maximize or minimizes their given functions. GA is heuristic in procedures, so they are not guaranteed to find the optimal solutions to complex problems. However, literature review has shown that GA are able to find very good solutions for a wide range of problems such as outlier detection. Genetic algorithm was used for feature selection and classification in outlier detection on data sets. The result obtained claimed that the algorithm was effective for outlier detection in a wide research domain. [3]

Researchers have done lot of work in selection phase of GA but significant work is yet to be done with regards to outlier detection in fingerprint images. In this paper, the focus was on selection phase of GA considering roulette wheel, rank and tournament methods with the goal of comparing and determine the technique that performed best. In selection stage, individuals were chosen in the population that created offspring for the next generation and how many offspring each would create. The purpose of selection was to emphasize fittest individuals in the population in hopes that their offspring would in turn have even higher fitness. Roulette wheel, Rank and tournament were used as GA feature selection methods for outlier detection in fingerprint images. Roulette wheel performed better in terms of accuracy [7].

II. GENETIC ALGORITHM USING Roulette Wheel FEATURE

In Roulette Wheel selection technique, all the chromosomes in the population are placed on the roulette wheel according to their fitness value. Each individual is assigned a segment of roulette wheel whose size is proportional to the value of the fitness of the individual [3]. This is a selection style where the selection probability is proportional to absolute fitness. In proportional roulette wheel, individuals are selected with a probability that is directly proportional to their fitness values i.e. an individual's selection corresponds to a portion of a roulette wheel. The probabilities of selecting a parent in spinning a roulette wheel with the size of the segment for each parent being proportional to its fitness. Partially mapped crossover was selected to limits the possibility of invalid chromosomes.

Genetic Algorithm for roulette wheel

i Population size K ; Objective function F ( )
ii Crossover probability Pco
iii Mutation probability Pmu
iv Fitness threshold T
v Begin
vi do
vii Determine the fitness of each chromosome F(i)
i = 1,2,…….,K
viii Select the chromosome using roulette wheel
ix do
x Select two chromosomes with highest score
xi If (Rand[0,1] < Pco) then
xii Crossover the pair of chromosomes
xiv else
xv Change each chromosome with Pmu
xvi Remove the parent chromosomes
xvii until N offsprings have been created
xviii until any chromosome' s score fit F( ) exceeds T
xix return highest fitness chromosomes (best features)
xx end

III. GENETIC ALGORITHM USING RANK FEATURE SELECTION

In rank selection technique, the population and every chromosome receives fitness from the ranking. The worst has fitness 1 and the best has fitness N. It results in slow convergence but prevents too quick convergence. It also keeps up selection pressure when the fitness variance is low. It preserves diversity and hence leads to a successful search. In Linear Rank selection, individuals are assigned subjective fitness based on the rank within the population. The individuals in the population are sorted from best to worst according to their fitness values. Each individual in the population is assigned a numerical rank based on fitness, and selection is based on this ranking rather than differences in fitness [4].

Genetic Algorithm for rank feature selection is as follows:

i Population size K ; Objective function F ( )
ii Crossover probability P_{co}
iii Mutation probability P_{mu}
iv Fitness threshold T
v Begin
vi do
vii Determine the fitness of each chromosome F(i)
i = 1,2,…….,K
viii Select the chromosome using rank
ix do
x Select two chromosomes with highest score
xi If (Rand[0,1] < P_{co}) then
xii Crossover the pair of chromosomes
xiv else
xv Change each chromosome with P_{mu}
xvi Remove the parent chromosomes
xvii until N offsprings have been created
xviii until any chromosome' s score fit F( ) exceeds T
xix return highest fitness chromosomes (best features)
xx end

IV. GENETIC ALGORITHM USING TOURNAMENT FEATURE SELECTION

Tournament selection: GA uses this selection mechanism to select individuals from the population to insert into a mating pool. Individuals from the mating pool are used to generate new offspring, with the resulting offspring forming the basis of the next generation. A tournament selection mechanism in GA is simply a process that favours the selection of better individuals in the population for the mating pool. The selection pressure is the degree to which the better individuals are favoured: the higher the selection pressure, the better individuals are favoured [5]

The Genetic Algorithm for rank feature selection is as follows:

i Population size K ; Objective function F ( )
ii Crossover probability Pco
iii Mutation probability Pmu
iv Fitness threshold T
v Begin
vi do
vii Determine the fitness of each chromosome F(i)
i = 1,2,…….,K
viii Select the chromosome using Tournament
ix do
x Select two chromosomes with highest score
xi If (Rand[0,1] < Pco) then
xii Crossover the pair of chromosomes
xiv else
xv Change each chromosome with Pmu
xvi Remove the parent chromosomes
xvii until N offsprings have been created
xviii until any chromosome' s score fit F( ) exceeds T
xix return highest fitness chromosomes (best features)
xx end

V. EXPERIMENT DESIGN, RESULT AND DISCUSSION

This section focuses on the experimental design, results that we collected and their comparative analysis. The implementations in Mat Lab 2016 environment. The data collected for this work includes three hundred (300) fingerprint images acquired from selected students of Osun State College of Technology, Esa-Oke, Osun State, Nigeria. The images were in jpeg format with resolution of 100 X 100. The images were enhanced using Histogram equalization. Two hundred (200) fingerprint images were trained and one hundred (100) fingerprint images were used for testing. For

our experiments, the selected features using roulette wheel, rank and tournament were loaded into *K*-NN, after which k-fold cross validation method was employed as classifier for training and testing to determine outliers. The value of *k*, which was the nearest data point was selected using Euclidean distance function stated below.

Using $x_i \ldots x_k$ to represent the k instances from training samples that are nearest to x_q in Euclidean distance

$$d(x, y) = \sqrt{\sum_i (x_i - y_i)^2}$$

Where x and y are two instances with i^{th} input attributes x_i and y_i, .

The supervised machined learning experiment was carried out using several user-set threshold values to determine the best result for outliers. From the experiment, the best result was achieved for accuracy in outlier detection at threshold 0.47 as shown in Table 1. The graphs of selection methods in terms of accuracy, precision, specificity and computation time are shown in Figures 1 to 4.

Table 1: Result for GA selection methods for outlier detection on fingerprint images

Methods	*Thresh.*	*Accuracy (%)*	*Precision (%)*	*Specificity (%)*	*Comput.. Time(s)*
Roulette Wheel	0.47	86.43	89.12	66.75	121
Rank	0.47	84.72	90.16	66.52	116
Tournament	0.47	79.20	80.15	66.54	132

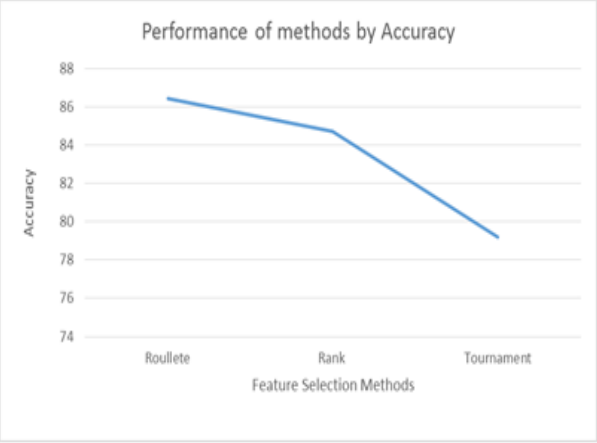


Figure 1: Graph of performance by accuracy

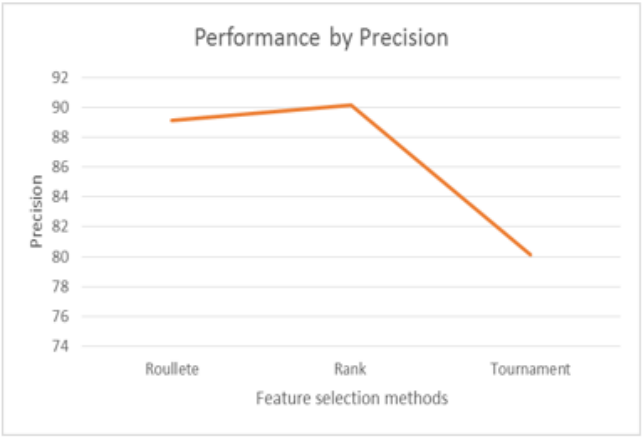


Figure 2: Graph of performance by precision

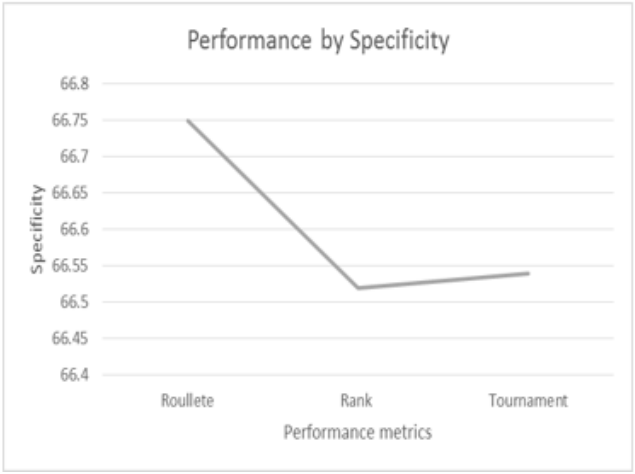


Figure 3: Graph of performance by specificity

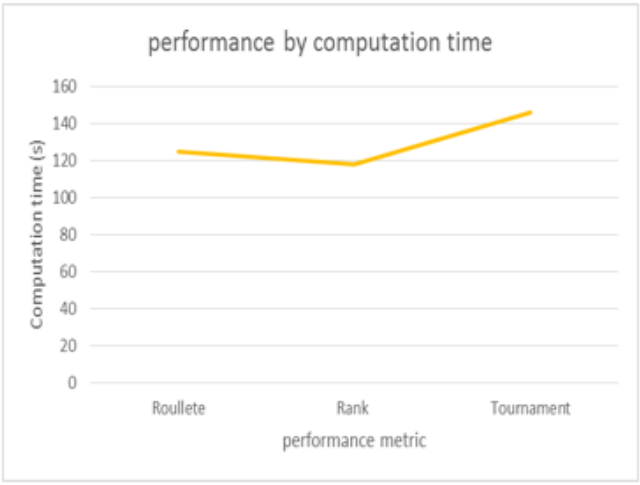


Figure 4: Graph of performance by computation time

In conclusion, according to the experiment conducted, roulette wheel gave the best result in term of accuracy. It was then followed by rank and tournament selection techniques respectively. Considering precision metric, rank selection method outperformed other methods. Roulette wheel also

performed best in terms of specificity. However, rank selection method gave the best result in term of computation time, followed by roulette wheel and tournament selection respectively. It was observed that the three selection methods performed very well for the purpose of outlier detection in fingerprint images with roulette wheel performing best in terms of accuracy and specificity. Rank feature selection method outperformed other methods in precision and computation time.

VI. ACKNOWLEDGEMENT

The authors wish to thank the staff members and students of Computer Science of Osun State College of Technology, Esa-Oke, Nigeria, for giving us the necessary support during the acquisition of the fingerprint images used in this study and during the testing of the system.

REFERENCES

1. Holland J.H. (1975) "Adaptation in natural and artificial systems: an introductory analysis with applications to biology, control, and artificial intelligence." *University of Michigan Press, Oxford*..
2. Maria Afzal and S. M. Arif Ashraf. (2016). "Genetic Algorithm for Outliers Detection" *International Journal of Computer Science and Information Technology*. 7(2)
3. Noraini Mohd Razali, John Geraghty, (2011)" Genetic Algorithm Performance with Different Selection Strategies in Solving TSP", *Proceedings of the World Congress on Engineering 2011 Vol II*..
4. Saneh Lata Yadav and Asha Sohal (2017) " Comparative Study of Different Selection Techniques in Genetic Algorithm*"* *International Journal of Engineering, Science and Mathematics* Vol. 6 Issue 3, July 2017, ISSN: 2320-0294Spector, A. Z. 1989. Achieving application requirements. In Distributed Systems, S. Mullende
5. Sivanandam, S.N. and .Deepa,S.N. (2008) "An Introduction to Genetic Algorithms" *Springer-Verlag Berling Heidelberg*Fröhlich, B. and Plate, J. 2000. The cubic mouse: a new device for three-dimensional input. In Proceedings of the SIGCHI Conference on Human Factors in Computing Systems.
6. Yadav and Sohal (2017). "Comparative Study of Different Selection Techniques in Genetic Algorithm**"** *International Journal of Engineering, Science and Mathematics Vol. 6 Issue 3, ISSN: 2320-0294*
7. Efunboade Ayodeji Oyeyinka, Adewale Josehp Adewale, Lawal Nurudeen Tunde A., and Sarumi Olusegun Ajibola (2020) "Performance Evaluation of Selection Methods of Genetic Algorithm in Outlier Detection "*International Journal of Innovative Research and Advanced Studies (IJIRAS) Vol. 7 Issue 10 ISSN: 2394-4404.*