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Stress Diagnosis among Academic Fraternity using Bird-Based Soft Computing Techniques

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Abstract: Stress is a severe psychological disorder that has a significant impact on psychological and physiological behavior of academic fraternity. To evaluate the rate of educational stress among students and teachers, a dataset of academic fraternity is collected and examined. To discover an optimal set of characteristics for a bi-objective stress diagnosis problem, three different bird-based swarm Intelligence (SI) metaheuristic algorithms namely Crow search algorithm (CSA), Emperor penguin optimizer (EPO), and Harris hawk Optimization (HHO) has been explored. The performance of these methods in discovering optimal set of features required for stress diagnosis among academic fraternity has been explained.

Keywords: Cylinder block, V8 engine, design, analysis

1. INTRODUCTION

Stress is a prevalent psychological disorder that has a detrimental impact on the victim's physical and mental well-being. [1]. Nowadays, a large number of s people are suffering from stress, and the number of people affected by this terrible condition is rapidly increasing [2]. Acute, episodic, and chronic stress are the three types of stress that exist in general [3]. Stress has a substantial link with various chronic and life-threatening human illnesses, according to studies [4]. Long-term stress can cause major health issues. Furthermore, it is a big contributor in heart, digestive, psychiatric, pulmonary, and reproductive problems in humans [5].SI-based computing approaches have been widely and successfully applied to a wide range of real-world problems. Some of the key application areas for these techniques are query optimization [6, disease detection [7], stock prediction [8], supply chain management [9], and inventory control [10].

Several computational techniques have been devised and employed for early and exact diagnosis of various chronic and life-threatening human ailments throughout the last three decades [11][12]. Swarm intelligence approaches have a significant impact on the detection of a diversity of human diseases, including heart disease, cancer, and diabetes [13]. SI metaheuristics are newly developed nature-inspired computer techniques that use the social behaviour of various species (nature) to address various real-world problems. These methods are also becoming increasingly widely used in a range of healthcare applications. These techniques are effective because they are simple to implement; no gradient information is necessary, and they may be utilised in a variety of fields.

Three distinct bird based SI metaheuristic approaches were used in for diagnosis of stress from academic fraternity. The effectiveness of three bird-based metaheuristic strategies, Crow search algorithm (CSA), Emperor penguin optimizer (EPO), and Harris hawk Optimization (HHO), in addressing a bi-objective stress diagnostic problems has been analyzed. The accuracy, sensitivity, and specificity have been computed and studied. No one has investigated the performance of these SI-based feature selection strategies for the stress-diagnosis among students and teachers. The remainder of the article is structured as follows. In section 1, description of data set is discussed. In section 2, three bird based techniques has been discussed. In section 3 result analysis is discussed and in section 4, finally, concluding remarks followed by future directions are discussed.

2 MATERIAL AND METHODS

2.1.1 Data Set 1(D1)

The Dataset D1 (Student fraternity) consist of 2507 instances contains 13 attributes related to personal information (such as name, city, gender, age, locality residence, father's source of income, mother's source of income, college name, pursuing education) and the remaining 60 attributes are stress indicators (such as stress during first semester of college/ university, stress during final Year Projects/Training, stress d during final Year Projects/Training, stress d during final Year Projects/Training, stress d during final Year Project The responses to these questions were categorised into five categories (on a five-point Likert scale): (0- never, 1- seldom, 2- occasionally, 3- fairly often, 4. very often).

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2.1.2 Data Set 2

Dataset D2 (teacher stress dataset)contains 507 instances of college and university teachers and 80 attributes, 14 of which are personal information (such as gender, age, residence, job experience, designation, working hours, and so on), and the remaining 66 attributes are stress indicators (such as undisciplined students, lack of cooperation from students, and so on).

2.2 Methods

In the last three decades, several swarm-intelligent techniques (based on natural phenomenal) have been designed and employed to solve different real-life optimization problems. Based upon the principles used in the design of swarm-intelligent computing techniques, these can be broadly classified as physics-based, chemistry-based and biology-based techniques In this manuscript, three bird based swarm intelligence techniques EPO, HHO and CSA for the diagnosis of stress among academic fraternity.

2.2.1 Emperor penguin optimizer (EPO)

The Emperor Penguin Optimizer Algorithm (EPO) is based on emperor penguins' huddling habit [14]. EPO's basic steps are to create the huddle boundary, calculate the temperature around it, calculate the distance, and get the effective mover. Emperor penguins are highly sociable animals that live and feed in big groups. They have developed a method of actively aggregating to benefit from the warmth of conspecifics in response to low ambient temperatures. Because emperor penguins do not have a nest for breeding and no individual territory, they can form huddles of thousands of individuals, which provide them with effective protection from cold temperatures and wind. They can withstand the bitter cold of an Antarctic winter, when temperatures drop to -20 °C or below. To avoid freezing to death, they cuddle together in close quarters to retain heat and protect themselves from the strong winds [15].

Emperor Penguin Optimizer techniques have been proposed to handle a wide range of real-world engineering optimization issues [16]. Constrained or unconstrained issues, discrete or continuous problems, static or dynamic problems, single or multi-objective problems are all separated into different groups.

2.2.2 Harris Hawk Optimization (HHO)

Harris hawks optimizer (HHO) is a swarm-based optimization method developed by Heidari et al. [1]. The main idea behind HHO is to mimic the action and reaction of Hawk's team collaboration hunting in nature and prey escaping to discover the solutions of the single-objective problem. In HHO, hawks chasing actions represent search agent, while prey represents the best position. HHO can play a significant role in solving different real-world optimization problems (e.g., engineering design and optimization problems, pattern recognition problems, manufacturing optimization problems, and geotechnical engineering problems, power quality problems, feature selection problem, image segmentation problems, and drug design problem). Also, the HHO can be utilized to tackle the problems with the unknown types of search space and solve the problems including discrete and continuous spaces [2], provide better solution quality [3–5], provide high accuracy in extracting the optimal parameters [6, 7] & Hamzeh Mohammad Alabool h.alabool@seu.edu.sa Deemah Alarabiat d.alarabiat@seu.edu.sa Laith Abualigah laythdyabat@aau.edu.jo Ali sghar Heidari as_heidari@ut.ac.ir

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123 Neural Computing and Applications https://doi.org/10.1007/s00521-021-05720-5(0123456789().,-olV)(0123456789().,-volV) Content courtesy of Springer Nature, terms of use apply. Rights reserved. and enhanced the prediction performance [8, 9]. Further- more, [10–15] ensured that HHO is a potentially powerful optimizer that helps to solve complex nonlinear problems and find the optimal solution faster, and simple computational procedure. More details about the optimization algorithms can be found in [16–18]

Heidari et al. developed the Harris hawks optimizer (HHO), a swarm-based optimization algorithm[17]. The main goal of HHO is to replicate Hawk's team collaboration hunting in nature and prey escaping in order to find answers to the single-objective challenge. Hawks hunting prey represent the ideal position in HHO, while hawks chasing actions indicate the search agent. HHO has the potential to help solve a variety of real-world optimization challenges (e.g., engineering design and optimization problems, pattern recognition problems, manufacturing optimization problems, and geotechnical engineering problems, power quality problems, feature selection problem, image segmentation problems, and drug design problem). In addition, the HHO may be used to solve problems involving unknown types of search space and solve problems involving discrete and continuous spaces [18], improve solution quality [19], and extract optimal parameters with high accuracy [20] and improved prediction accuracy. Furthermore, demonstrated that

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HHO is a potentially powerful optimizer that aids in the faster solution of difficult nonlinear problems and the identification of the optimal solution [21].

2.2.3 Crow Search Algorithm (CSA)

Askarzadeh proposed a new population-based algorithm called Crow Search Algorithm (CSA), which simulates crow food hiding behavior [22]. CSA is a recently created swarm intelligence programme that mimics crow behavior in terms of storing excess food and retrieving it when needed. The crow is the searcher, the surrounding environment is the search space, and randomly storing the position of food is a viable approach, according to optimization theory. The global optimal solution is believed to be the place with the most food stored among all food locations, and the objective function is the amount of food. CSA attempts to find optimal solutions to various optimization issues by replicating the intelligent behaviour of crows. It has sparked widespread interest due to its benefits, which include ease of implementation, a small number of parameters, adaptability, and so on [23].

3. RESULTS AND DISCUSSIONS

3.1 Performance Analysis

Here, several experiments were carried out over the above-mentioned dataset using three individual (EPO, CSA and HHO) SI metaheuristic techniques. To avoid the bias in the results, the some experiments have been executed thirty times. The minimum, maximum and average value of accuracy, sensitivity and specificity achieved using EPO, CSA and HHO have been depicted in Table 1, 2 and 3 respectively.

Table 1.Maximum rate of classification

Algorithm/Datasets		EPO	HHO	CSA
D1	Min	0.875	0.867	0.880
	Max	0.885	0.876	0.921
	Avg	0.88	0.871	0.900
D2	Min	0.847	0.813	0.857
	Max	0.891	0.887	0.909
	Avg	0.869	0.85	0.883

Table 2: Maximum rate of Sensitivity

Algorithm/Datasets		EPO	HHO	CSA
D1	Min	0.887	0.890	0.895
	Max	0.891	0.897	0.911
	Avg	0.889	0.893	0.903
D2	Min	0.865	0.872	0.896
	Max	0.900	0.920	0.932
	Avg	0.882	0.896	0.914

Table 3: Maximum rate of Specificity

Algorithm/Datasets		EPO	HHO	CSA
D1	Min	0.811	0.733	0.831
	Max	0.850	0.760	0.889
	Avg	0.830	0.746	0.861
D2	Min	0.807	0.829	0.839
	Max	0.821	0.858	0.864
	Avg	0.814	0.843	0.851

It has been found that the maximum rate of classification (accuracy) achieved by CSA (92%) is 4% and 5% better than EPO and HHO respectively.

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4. CONCLUSION

In this research work, three bird based swarm intelligence metaheuristic techniques (EPO, HHO and CSA) have been applied for stress diagnosis among academic fraternity. Performance of three bird based swarm intelligence has been analyzed on stress related datasets. The performance of CSA is found to be superior as compared to EPO and HHO. In the future, the effectiveness of these three techniques can be analyzed with deep learning techniques.

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