Genetic Approach Weighted Support Vector Machine for Structural Failure Prediction of RC Building

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Abstract- In this work Failure prediction in RC buildings is proposed by using the Genetic algorithm and K-nearest neighbor algorithm. These algorithms give the optimal result of the classification and prediction in this work. Optimization techniques play an important role in structural design, the very purpose being to find the best ways for a designer or decision-maker to make the most of available resources. The basic idea of intuitive or indirect design in engineering is the memory of past experiences, subconscious patterns, incomplete logical processes, random selections, or sometimes mere superstition. This, in general, will not lead to the best design.

Keywords- rcc,prediction classification , structure

I. INTRODUCTION

Development method play a significant role in the design of structures, the objective which is to find super ways or techniques by which the designer or the decision makers can generate the maximum profit from the existing resources at hand. An engineer's main aim is to progress with an 'optimum design' for the concerned design job. An absolute solution usually demonstrates a beneficial structure without destroying the useful purposes. There is huge number of promising beam sizes and increased ratio's that outcome for the same moment of struggle, then it became tough tasks to achieve the least-cost construct by knowable iterative prospective. The mechanism of optimization can help designers to grab the best design.

Reinforced concrete is a combination of concrete and steel plates which enhance the strength of the concrete. This type of concrete is able to resist the applied force together. The combination of steel and concrete gives effective strength and able to handle the largest vibrations of earthquakes, winds and other forces. Basically it is and economic building material which is used now the days in most of the building construction. It is used in construction of beams, columns and storage structure like dams, tunnels and water tanks.

Reinforced concrete structures are basically built with concrete being reinforced with steel reinforcement. Concrete is weak in tension, thus to make up for it , steel reinforcement is added to the member, thus resulting in formation of reinforced cement concrete structures. Thus concrete is strengthened both in tension and compressions. It is this property of reinforced concrete structures that lets the designer's build limitless structures, pushing every boundary that existed earlier. This has resulted in vast expanse in construction of dams, bridges, buildings, water tanks, shell structures etc.

Due to this widespread use of reinforced concrete, it has become all the more important for every civil engineer to know the principals involved in the design and execution of Reinforced concrete structures

II. LITERATURE REVIEW

The structural failures in RC buildings are due to improper design and material used in the columns and beams. Mainly the cracking in columns and infill walls are the issues in the RC buildings. This is occurred due to weakness of structure and poor quality of materials. Chatterjee et al presented the novel hybrid approach of particle swarm optimization with artificial neural network for the structural failure prediction of multistoried RC buildings. The PSO algorithm is used to get the optimized weight vector with RMSE (root mean square error). This approach solved the issues like complexity that faced in the traditional method [1]. Hore, Sirshendu, et al. presented a technique based on the neural network for the prediction of failure in the RC buildings. Artificial neural network works effectively to solve the real life problems and tested on the prediction failure. Multi-layer perceptron feed forward network classifier is used for prediction and failure detection of the buildings. The approach is tested on the large number of buildings which are constructed by the professional engineers. The testing is done by using the 15 features and it gives effective results with accuracy [2]. M. Hakan et al. also worked on the ANN model to determine the failure and prediction on the RC buildings. The ANN is allied on the parameters like columns, beams, and load level and compression bar ratio. It performs the non linear analysis on the defined parameters [3].

R. Kumar et al presented optimization of synchronization costs, topology and standard cross-sections of single-storey industrial building structures. The main portals commonly associated with failures are taken into account. The optimization was performed by a genetic algorithm method [4]. S Patil and his colleagues presented in their research and presented a study on the best possible design of the detailed flat slab reinforced with the drop panel according to IS 456-2000. The total cost of columns and slab and all of its elements serves as an objective function. The cost of each component includes the cost of equipment used, labor and formwork. Optimization is performed in the MATLAB software using the direct design

method. Different grades of steel and concrete are considered for the optimization illustrations. By using the unconstrained sequential minimization technique, the nonlinear programming problem is optimally formulated [5].

S.T Yousif and R.M. In their study, Najem discussed the application of genetic algorithms to the cost optimization of protected concrete beams based on the provisions of the ACI standard. The resulting optimized design meets all requirements in terms of strength, ease of maintenance, ductility, durability and all other design and detail constraints. In this study, reinforcing steel dimensions were introduced as a variable taking into account the influence of bending, shear and torsion on the beam. The forces, the moments and the deformations necessary for the genetic algorithm will be found by examine [6]. The optimal results were calculated and compared with the results of the previous literature. A. Kaveh and MS Massoudi analyzed the ant colony system model to optimize the costs of an amalgamate floor system based on AISC load factors and cost comparison design specifications. the cost of the structure that can be reduced based on the type of work in the structure [7].

A.Kaveh and AF Benham proceeded to optimize the costs of a multi-stage system using a loaded system search algorithm and discussed optimization of the design of special floor systems including multiple waffle plates. All this is done using the latest meta-heuristics algorithms. The most favorable design is based on LRFD-aisc and ACI 318-05. The purpose function is the cost function. The cost function includes the cost of all materials used and construction costs. The problem is also optimized by using an improved algorithm of the Harmony search system, and then compared to the output of the search algorithm of the loaded system [8]. A.Nimtawat and P Nanakorn shows that the PSO algorithm for the design of the layout of the beam slab distributes with the measurement of slab layout design is analyzed and not algorithmic because the procedure can not be segmented into algorithm. In this research, the design work is written as an optimization problem, which can be solved by following appropriate target and reduction functions based on engineering considerations. A simple PSO used to solve the problem of optimization. It has also been found to be the most popular method because of its simplicity and excellent presentation. To use this technique, an encoding strategy is used for the layout of the beam slab [9].
A.C Galeb and Z.F Atiyah presented the optimal design of additional concrete waffle slabs designed with the optimal design to reinforce concrete wafer slabs using genetic algorithms. Two case studies were explained: the first is a wafer slab with solid heads and then the waffle slab with a band beam in the center lines of the column. The limitation involves restrictions on the measurements of the rib and the limitation at the top of the slab width, the stress on the area of the steel reinforcements to satisfy the bending behavior and provide sufficient concrete cover. A computer program is written with the use of MATLAB to evaluate the structural survey and design the slab waffle by direct design techniques. The optimization procedure performed using the built-in genetic algorithm toolbox of matlab [10].

III. PROPOSED WORK

A Genetic algorithm

Genetic algorithm is a constant procedure that is influenced by the 'survival of the fittest' principle of Darwinian. The expansion frequently begins from population of randomly formed individuals and is an iterative procedure; each iteration termed as generation. Moreover, fit individuals stay problematically listed from the existing population and all individual genes are changed to devise new generation. The latest produced candidate solutions is used for the another change in the algorithm. Normally, the algorithm stops at any time a supreme number of generations have been produced or a sufficient level has been attained.

- **Initialization of Genetic algorithm:** In the start various individual solutions are normally produced in either way for appearance an initial population. The size of the population is reliant on the nature of issue but usually incorporate hundreds and thousands of solutions. Consistently, population is produced in either way, letting the full variance of available solution.
- **Selection:** The dependency of fitness occupation is on the genetic demonstration and measured the quality of featured solution. The fitness function is randomly reliant on the problem. In a knapsack of some static capability there is lust to increase the total magnitude of objects that can be positioned.

B Support Vector Machine

Support Vector Machine, and is popular tool for supervised machines learning methods which are based on the minimization of the structural risk. The SVM basic characteristics is the original non-linear data into data class and the separation margin among itself is maximized and typing points nearer from the support vectors.

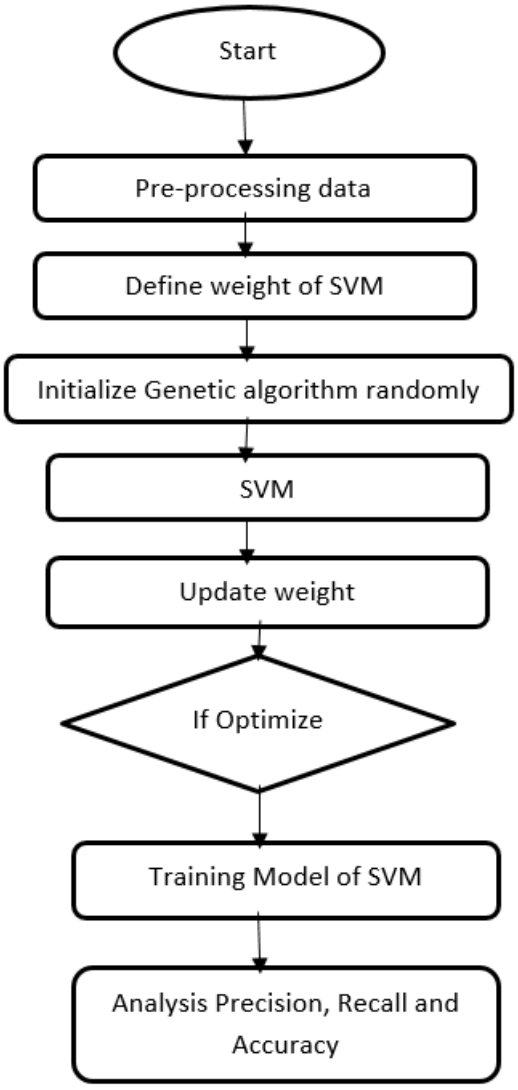

Figure Flow Chart of the proposed work

IV. RESULTS AND DISCUSSION

This section deals with all the outcomes accessed from the whole study. The whole research takes into account various parameters that have been described in the earlier chapters, while coming on to the results. In the proposed approach genetic algorithm with SVM is used for optimize the prediction of result in the multi-storied RC-buildings.

Table 1 Results on the different algorithms

Classification	**Accuracy**	**Precision**	**Recall**
PSO	60	55	66
G.A+SVM	70	94	96
SVM	67	67	56

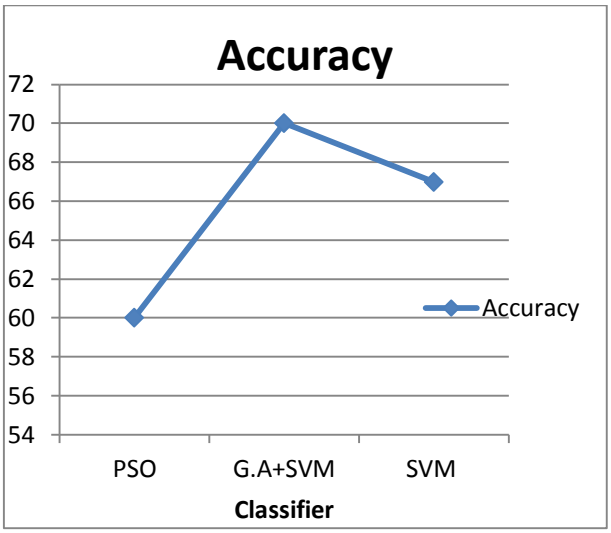

Fig.1: Accuracy graphs of classifiers

Figure 1 depicts the accuracy of the Particle Swarm Optimization, Genetics Algorithm-SVM, and SVM classifiers. The high accuracy 70 % in graph shown by Genetics Algorithm-SVM and minimum by PSO 60.

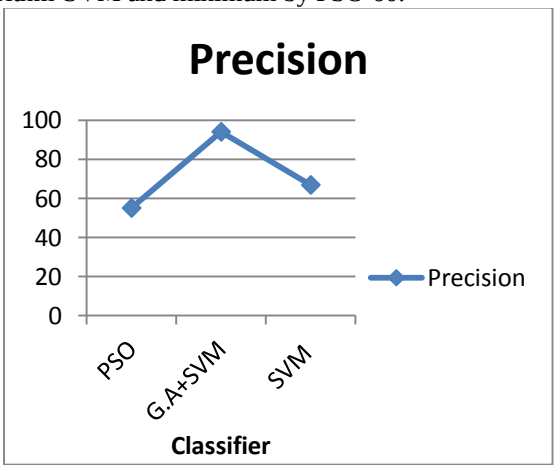

Fig.2: Precision graphs of classifiers

Figure 2 depicts the precision of the Particle Swarm Optimization, Genetics Algorithm -SVM, and SVM classifiers. The highest precision is 94 % in graph shown by Genetics Algorithm-SVM and minimum by PSO 67.

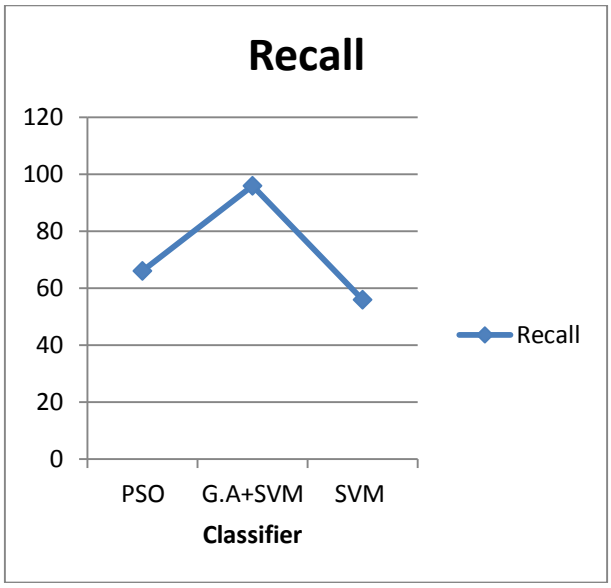

Fig.3: Recall graphs of classifiers

Figure 3 depicts the recall of the Particle Swarm Optimization, Genetics Algorithm -SVM, and SVM classifiers. The high recall 96 % in graph shown by Genetics Algorithm-SVM and minimum by PSO 56.

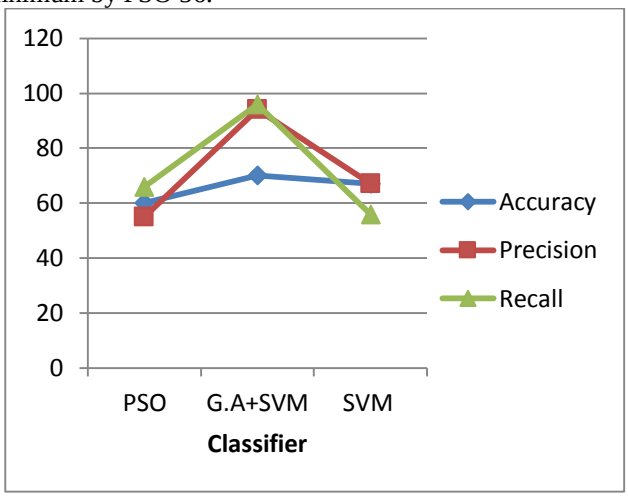

Fig.4: Comparison graphs of classifiers

Figure 4 depicts the comparison of accuracy, precision and recall of the Particle Swarm Optimization, Genetics Algorithm-SVM, and SVM classifiers. The outcome of the G.A+ SVM depicts the effective accuracy, precision and recall which help in the failure prediction of the R.C Buildings. The more the accurate results gives the more accuracy in failure and this comes from the optimization of the algorithm we used in the proposed method.

V. CONCLUSION

In this work Failure prediction in RC buildings is proposed by using the Genetic algorithm and K-nearest neighbour algorithm. These algorithms give the optimal result of the classification and prediction in this work. Optimization techniques play an important role in structural design, the very purpose being to find the best ways for a designer or decision-maker to make the most of available resources. The basic idea of intuitive or indirect design in engineering is the memory of past experiences, subconscious patterns, incomplete logical processes, random selections, or sometimes mere superstition. This, in general, will not lead to the best design.

VI. REFERENCES

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