

Applying Genetic Algorithm in Intrusion Detection System of IoT Applications

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Abstract—Internet of Things (IoT) is a rapidly growing technology nowadays. It has many applications in daily life equipment and used in various ways to improve the daily life of a human being. The applications of IoT is not limited to any area. The research is going to discover more areas in which IoT is applicable. The IoT applications have many areas in which there is a need to optimize things more. Intrusion Detection System is a system that monitors an internet based application for malicious activities. Genetic Algorithm is a heuristic technique to solve optimization problems. In this paper, a new approach for IDS using a genetic algorithm is proposed. The proposed algorithm is applied on a KDD99 cup data set to check its performance.

Keywords—Internet of Things; Genetic Algorithm; Computer Security; IoT Applications

I. INTRODUCTION

Internet of Things (IoT) a concept that connects any device with internet. It also connects the device with the internet and other connecting devices. IoT [5][6][7] can be thought of a very large network in which devices are connected through the internet. The devices may have sensors which capture and collect the data and use this data in some application after processing it. IoT [5] is used to make very smart devices such as driverless cars, fitness devices, home security equipment and many more. When making IoT devices, it faces lots of problems in which some of the problems are optimization problems. Figure 1 is showing many applications areas of IoT in recent years [6][7].

Genetic Algorithm [2] is an evolutionary-based algorithm which is very useful in solving optimization problems. It has many application areas in which there is a need for optimization [2][3][4]. The application areas of optimization problems are also the application areas of the genetic algorithm such as Knapsack problem, TSP problem and many more. The process of the genetic algorithm starts with the generation of the initial population. Genetic Algorithm then uses its special operators such as selection, cross over and mutation repeatedly till a desired solution of the problem is not found. Figure 2 is showing a flowchart of a genetic algorithm.

In the initial population generation phase, a set of candidate solutions for the problem are generated. This set is called the

initial population of the genetic algorithm and all the candidate solutions are called chromosomes. The fitness function is then applied to all the chromosomes which calculate the fitness value of all the chromosomes. The fitness value [2][3] determines the quality of the chromosome. Using the genetic algorithm, the fitness value of the chromosomes of the population is improved by applying its genetic operators which are selection, mutation and crossover. In Selection operation, some of the chromosomes from the population are selected and participated in the cross over and mutation.

Various techniques for selection [2][3][4] are used such as random selection, greedy selection, tournament selection and many more. All the selected chromosomes are put into meeting pool to perform a cross over.

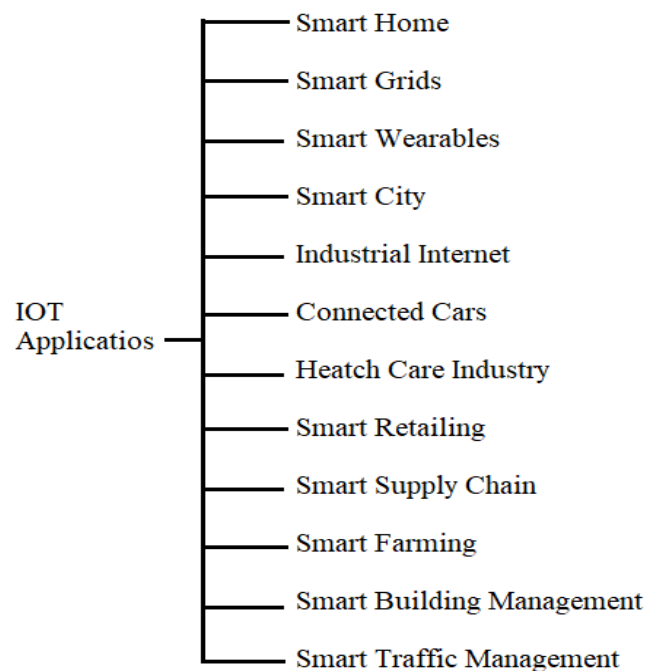


Fig 1. Applications areas of IoT

In cross over, a pair of chromosome from the meeting pool participates and generate children [2][3]. Various techniques of cross over are, one-point cross over, uniform cross over, greedy cross over, PMX cross over and many more. The children generated in the cross over phase are added in the population after calculating their fitness. Then the population undergoes for the mutation operation. In the mutation operation, a small portion of the population is mutated or modified randomly. The mutation operation put small accidental changes in the population and it is very important to discover hidden and good solutions from the population. The next section discusses some existing research work carried out by different researchers by applying genetic algorithm in IoT applications.

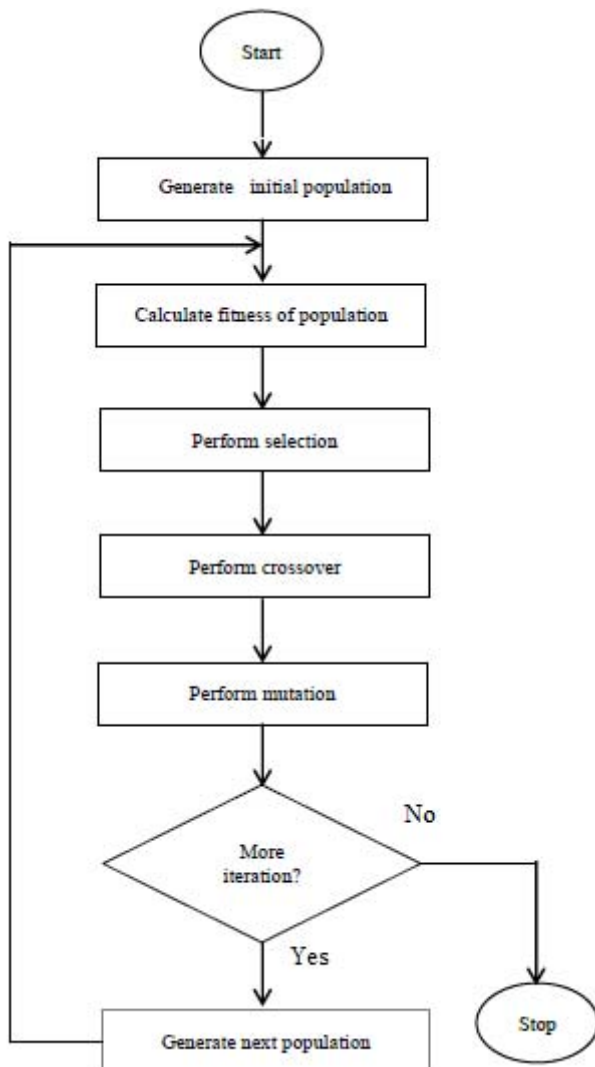


Fig 2. Flowchart of Genetic Algorithm

II. LITERATURE SURVEY

Z. Shen et al. [1] apply genetic algorithm for generation of organizational structure of IoT applications. The organizational structure which was generated using genetic algorithm was found better in quality as compared to other techniques. X.

Deng et al. [2] apply genetic algorithm in detection of outlier in the area of big data and internet of things. The detection of outlier in big data is a very common problem. The application of genetic algorithm solves the problem in a better way. J. Liang et al. [3] proposed an algorithm using genetic algorithm and neural network for movement in IoT applications. The proposed collaborative and energy efficient algorithm for the movement of the objects in the IoT applications. The movement of objects in IoT based applications suffers a lot of problems. The GA based solution was found good to control the movement of objects in IoT applications.

N. Lin et al. [4] proposed a genetic algorithm based solution of vehicle routing problem in IoT. Vehicle routing have many application areas in IoT based applications. The GA based solution of the vehicle routing problems was found good as compared to other existing problems. A. S. Hampiholi and B. P. Vijaya Kumar [5] also proposed genetic algorithm based solution of routing problems in IoT applications. H. Wang et al. [6] apply genetic algorithm in IoT applications. They proposed a genetic algorithm which was using spatial features in the configuration of network base stations in IoT applications. W. Mardini et al. [7] proposed an architecture for friendship selection using genetic algorithm in social IoT. B. Hussain et al. in [8] proposed a genetic algorithm based smart homes using IoT. The algorithm was mainly applicable for the homes in developing countries. Y. Zhang et al. [9] applied genetic algorithm in intrusion detection system in IoT applications. Y. Song et al. [10] proposed genetic algorithm based solution for IoT internet connection. The solution was proposed for satellite downlink replanting problem. M. Kim and I. Ko [11] applied genetic algorithm for resource allocation. The algorithm was applied in composite services of the IoT applications. Y. Wang et al. [12] apply genetic algorithm in supply chains. The supply chains which was based on IoT, the method proposed in [12] was applied. The algorithm was immune GA and was applied in Multi-Echelon applications to control the inventory cost. M. Cuka et al. [13] applied fuzzy logic and genetic algorithm in placement of IoT based devices in opportunistic networks. Many other researcher [14-28] also work on the same area to provide solution to the problems in this area.

After going through this literature, it is investigated that the genetic algorithm is used in many problem areas of IoT devices. IDS is a very important component of all the internet based applications. The next section discussed the proposed genetic algorithm for IDS system that is used for IoT applications.

III. PROPOSED WORK

In this paper, a new approach for intrusion detection system IDS using genetic algorithm for IoT applications is proposed. The proposed genetic algorithm use KDD'99 cup data set. The data set was introduced and generated by MIT Lincoln labs. will use this data set to generate the initial population and calculate fitness. Figure 3 is showing the proposed genetic algorithm for testing IDS using KDD99 cup data set.

A proposed genetic algorithm for intrusion detection system using genetic algorithm is as follows:

Algorithm: Genetic Algorithm based Intrusion Detection System for IoT applications.

Step 1. Initialize the population (using KDD99 Data set)
Step 2. Check the fitness of the population
Step 3. Perform Selection
Step 4. Perform Cross Over
Step 5. Performa Mutation
Step 6. If stopping criteria reach
then Stop

The proposed genetic algorithm for intrusion detection system in IoT applications will be implemented in any programming language like python or JAVA.

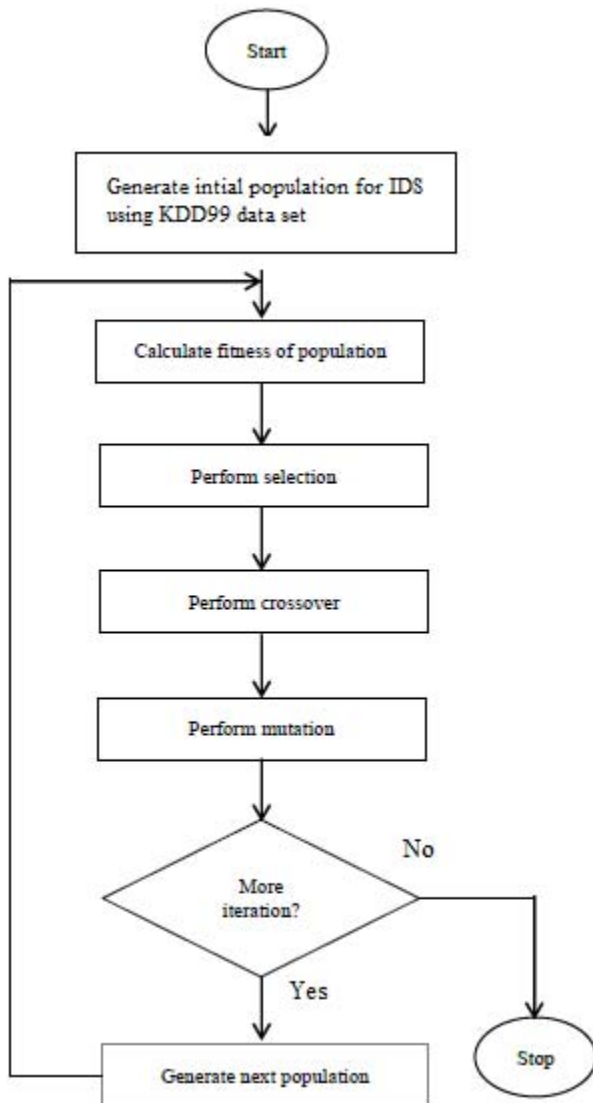


Fig3. Proposed Genetic Algorithm based IDS

In figure 3, the proposed system for providing security in IoT applications for IDS is explained. This work proposed the generation of the initial population using KDD99 dataset. The

next section discusses some conclusions and future scope of this work

IV. CONCLUSION AND FUTURE SCOPE

IoT applications are very useful now a day to improve the daily life of a common man. Many IoT based devices are introducing in recent years which are in use now a day. This paper proposed a new genetic algorithm that can be used in intrusion detection system of IoT based applications. It is concluded from this paper that; genetic algorithm is very useful in providing security to IoT based applications. This work has many limitations on which work can be done in future. Some of the future scopes of this work are as follows:

1. The improved genetic algorithm which uses improved selection, cross over and mutation operators can also be proposed and applied in IoT applications.
2. The proposed algorithm can be simulated and implemented using a programming language or standard tool and its results can be evaluated.
3. The complexity of the genetic algorithm based IDS can also be checked and compared with other techniques.
4. Hybrid and enhanced genetic operators can also be applied in this work to make it more optimized to provide better results.
5. The fitness calculation of the chromosomes for the genetic algorithm is yet to be decided.

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