

MODEL FOR INTRUSION DETECTION SYSTEM

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ABSTRACT

Advancement in wireless communications lead more and more mobile wireless networks e.g., mobile networks [mobile ad hoc networks (MANETs)], wireless sensor networks, etc. Some of the challenges in MANET include: Dynamic network topology, Speed, Bandwidth, computation capability, Scalability, Quality of service, Secure and Reliable routing. One of the most important challenges in mobile wireless networks is the Secure and reliable routing and the main characteristic of MANET with respect to security is the lack of clear line of defence. Therefore, the SP routing problem in MANET turns into dynamic optimization problem. In this paper, a path detection algorithm and a model to detect intruders that is misbehaving nodes in the alternative paths is proposed.

KEYWORDS

Mobile Ad Hoc Network (MANET), Intrusion Detection System (IDS), Shortest Path (SP), Genetic Algorithm (GA).

1. INTRODUCTION

A Mobile Ad Hoc Network (MANET) is a collection of wireless mobile nodes forming a temporary/short-lived network where all nodes are free to move about arbitrarily and where all the nodes configure themselves. This type of networks is suited in situations where a fixed infrastructure is not available. A few areas of application are Military communications, Search and rescue operations, ecommerce, home and enterprise networking etc. In MANET, each node acts both as a router and as a host & even the topology of network may also change rapidly. In the absence of a fixed infrastructure, nodes have to cooperate in order to provide the necessary network functionality. Mobile networking is one of the most important technologies supporting pervasive computing. Generally there are two distinct approaches for enabling wireless mobile units to communicate with each other [3]:

Infrastructure: Wireless mobile networks have traditionally been based on the cellular concept and relied on good infrastructure support, in which mobile devices communicate with access points like base stations connected to the fixed network infrastructure.

Infrastructureless: As to infrastructureless approach, the mobile wireless network is commonly known as an adhoc network or Mobile ad hoc network (MANET).

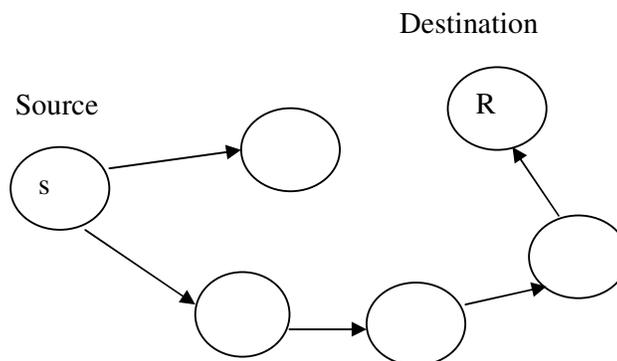


Figure 1: Ad hoc network example.

There are many existing routing protocols available for MANET and those can be categorized as table driven approach (proactive) and on demand routing protocols (reactive) [6]. The reactive routing protocol a route is established only when a source node wants a route to destination node.

2. SECURITY IN MANET

This section discusses some security goals and challenges that the field of ad hoc networking faces [1].

2.1. Security Goals

- (a) Availability: It ensures that network will provide all services. Denial of Service is an attack to availability.
- (b) Confidentiality: It ensures that certain information is never leaked to unauthorised user.
- (c) Integrity: It enables that the message send by source received by destination without being modified or corrupted.
- (d) Authentication: It allows users to be sure about the identity of other to whom it is communicating.
- (e) Non-repudiation: It enables the sender of the message not to deny of sending the message and the receiver of the message cannot refuse from receiving it.
- (f) Access and usage control: It ensures that access to information is controlled by the ad hoc network.

2.2. Security Challenges

The main security challenges that ad hoc networks face have been thoroughly analysed in the literature [1].

2.2.1. Link attacks

It includes attacks like

- Passive eavesdropping
- Message replay
- Message corruption.

2.2.2. Dynamic nature**2.2.3. Active Routing Attacks**

These kinds of attacks are very difficult to identify. Some of them are given below:

- Black Hole
- Routing Table Overflow
- Resource Consumption

2.2.4. Scalability**2.2.5. Secure routing****2.2.6. Quality of Service**

3. COMPARISON OF EXISTING PATH COMPUTING ALGORITHM WITH PROPOSED ALGORITHM

At present there are number of adhoc routing protocols that follow dijkstra's approach. This section is considering another algorithm, Floyd Warshall algorithm to find optimal path. The comparison of warshall's algorithm with Dijkstra's algorithm is presented as follows.

- Dijkstra's finds the optimal route from one node to all other nodes and Floyd-Warshall finds the optimal route for all node pairings.
- Dijkstra's runtime is $O(E + V \log V)$ where Floyd's is $O(V^3)$. Running Dijkstra for all nodes (represented as number of vertices) gives $O(VE + V^2 \log V)$. If $E = O(V^2)$, then the two are theoretically identical, with Floyd being faster in practice. Moreover, Floyd-Warshall does very few operations in the inner-loop so in practice Floyd-Warshall runs faster than Dijkstra for All-Pairs Shortest Path.
- Basically, Dijkstra's algorithm is applied when there are as many edges as there are nodes i.e. $E=O(V)$, and run Floyd's algorithm is used if we expect to have almost complete graphs i.e. $E=O(V^2)$.

4. OPTIMIZING THE RESULTANT PATH OBTAINED FROM THE PROPOSED ALGORITHM WITH GENETIC ALGORITHM

Genetic Algorithm (GA), first introduced by John Holland in the early seventies, is the search algorithm based on the mechanics of natural selection process (biological evolution). The GA design involves several key components: genetic representation, population initialization, fitness function, selection scheme, crossover and mutation [4]. A routing path contains of sequence of nodes in network. The genetic algorithm is applied to paths that is been obtained from the proposed algorithm (in the next section). A routing path is encoded by a string of 0's and 1's. The length of the string should not be more than the number of nodes present in the network.

4.1. Population Initialization

In GA each chromosome represents a potential solution and this can contain more than one solution initially [7]. The paths obtained from route discovery phase are considered as initial chromosomes.

4.2. Fitness Function

For a given solution, the quality is determined by the fitness function. Each chromosome is given a measure of fitness via a fitness function called as evaluation or objective function. The fitness of a chromosome determines its ability to survive and produce offspring. Our aim is to find the optimum path with lowest delay time. The fitness of each chromosome can be calculated as,[5]

$$f(Ch_i) = \sum_{(n=p(s,d))} (CO_n + RF) \tag{eq 1}$$

Where,

Ch= chromosome fitness value,

RF=the delay time taken by each chromosome,

CO_n = the cost of the path from source s to destination d.

The above fitness function is been maximized and involves only shortest path and delay constraint.

4.3. Selection scheme

Selection plays an important role in improving the average quality of the population by passing the high-quality chromosomes to the next generation. The selection of chromosome is based on the fitness value.

4.4. Crossover

The generations of the new solutions are developed by two basic recombination operators- crossover and mutation. Crossover includes combining of parent chromosomes to produce children chromosomes. It combines the fittest chromosomes and passes superior gene to next generation.

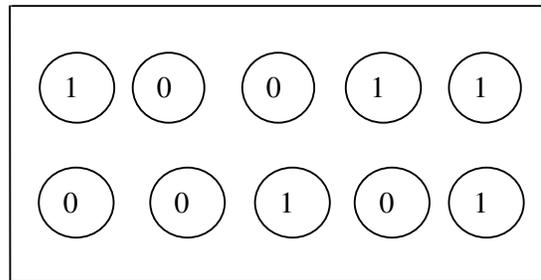


Fig 2: Initial chromosomes

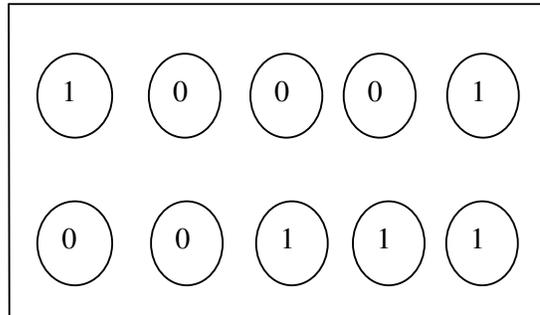


Fig 3: Offsprings produced after crossover

4.5. Mutation

Mutation includes altering some genes in chromosome. Mutation helps a GA keep away from local optima [2].

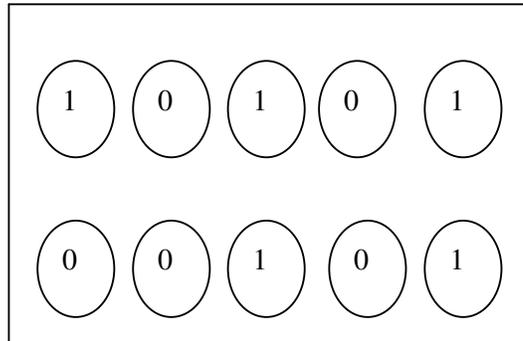


Fig 4: Child after mutation

5. STEPS FOR IMPLEMENTING THE PROPOSED MODEL

This section presents the pseudocode of the proposed algorithm and the steps to be taken to optimize the path obtained using GA.

5.1. Pseudocode for computing shortest path

#dist (i,j) is best distance so far from vertex i to vertex j.

#k is the intermediate vertex

#Start with single edge paths.

For i=1 to n do

 For j=1 to n do

dist (i,j) = weight(i,j)

 For k=1 to n do

 For i=1 to n do

 For j=1 to n do

 if (dist(i,k) + dist(k,j) < dist(i,j)) then
 #shortest path

 dist (i,j) = dist(i,k)+ dist(k,j)

5.2. Steps taken to optimize the path obtained using GA

In this subsection a flowchart is presented that depicts the step to be taken to optimize the path obtained using Genetic algorithm.

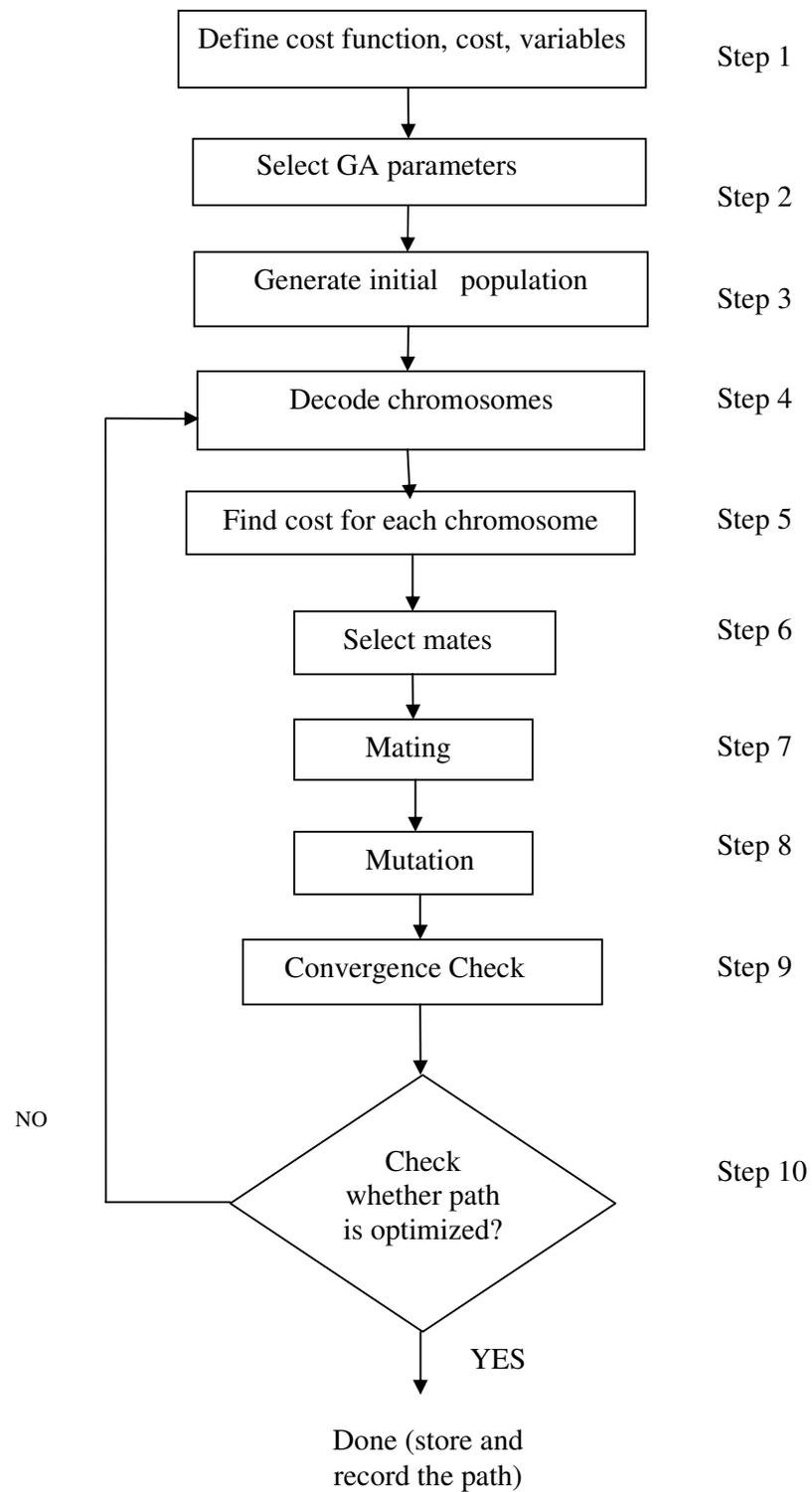


Fig 5: Flowchart of a binary GA

6. THE NEED AND SIGNIFICANCE OF PROPOSED MODEL

The need of proposed model is to remove the challenges of MANET such as security and reliability. The proposed model can compute appropriate route for communication and capable to obtain optimal, secure and reliable route. This model can be implemented for MANET routing environment that will be secure, reliable, optimal for several real life environment such as disaster management, rescue operations, military battlefield etc.

7. CONCLUSION

MANET is a self-organizing and self-configuring multihop wireless network, which has a wide usage nowadays. MANETs are an wide area for research with lots of practical applications. However, MANETs are vulnerable to attacks due to their dynamic topology, open medium etc. Thus security issue is becoming a main concern in the applications of MANET. According to the model It can be seen that after passing through the various steps of GA the information regarding the shortest path is optimized and provides the best and optimal path which will consider the problem of finding optimum path with least cost and least delay by using Genetic algorithm. It is hypothesized that the resultant path is more optimal and reliable with minimum of the malicious or misbehaving node in the system.

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