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# AN EFFICIENT APPROACH FOR DETECTION OF HEART ATTACK USING NOBLE ANT COLONY OPTIMIZATION CONCEPT OF DATA MINING

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## ABSTRACT

The goal of data mining is to extract knowledge from large amounts of data. Data Mining is an interdisciplinary field that focuses on machine learning, statistics and databases. In this article, we highlight a new framework that uses a combination of data extraction and ant colony optimization to collect heart disease such as early heart attacks to protect them and reduce mortality rates. This study focused on the formulation and implementation of an improved and reliable model for the diagnosis of heart attack disease with a sophisticated approach to data extraction, the Ant Colony Optimization technique. To do this, we first took the generated support, which will be used as the symptom weight, which will be the initial value of the pheromone. There are many types of heart disease that can be considered here Congenital Heart Disease Congestive Heart Failure Coronary Heart Disease. Based on the identified risk, we identify the maximum value of the pheromone; the maximum value of the pheromone is the addition of weight and risk level. The next step of the ant is to find the maximum value of the pheromone, as the sensitive ant movements and the ratio of the symptoms will change. With this approach, the number of fragments can be managed via the ACO parameter. Then we find the precision and the memory. With this approach we want to achieve higher recognition accuracy

**KEYWORDS**: Ant Colony Optimization, Heart Disease, K-Means Algorithm, Optimization, pheromone, Spectrums.

## I. INTRODUCTION

Data Mining is a technique used to extract hidden prediction information from sentences, databases and is a powerful technology with a lot of potential and useful both IT Businesses and medical fields to showcase the most valuable information in their data Warehouses. Tools for data mining have been developed to manage behavior and future movements Enable businesses to make knowledge-based decisions.

The main feature of Data Mining includes classification, mapping, and clustering. Due to the growing demand, different data mining techniques are used for better decision-making in the field of medicines too. Many medical organizations face a major challenge with quality services such as the correct diagnosis of patients and the provision of treatments where they occur often the man can pay the costs for their cure. Data mining techniques simplify many important and critical aspects problems related to health. In India and all abroad countries Heart Disease is a major challenge of medical science and specially it becomes dangerous due to lack of its prediction henceforth patients survival becomes compromised cause death[1-2].

In the year of 2003 nearly 17.3 million people died around the world and out of this, approximately 9 million were only because of the coronary heart disease. In 2008 17.3 million people died due to heart disease. More than 80% of passing away in world is because of coronary illness. WHO estimated by 2030 almost 23.6 million persons will pass away due to heart disease There are many such factors such as smoking, alcohol, obesity, high blood pressure, diabetes etc which creates such disease and responsible for the risk of having a heart problem. However nowadays, we can avoid such kind of diseases by getting better decisions at early stage with the help of advance techniques. [28-34]

The successful application of data mining in highly visible fields like e-business, marketing and retail has led to its application in other industries and sectors. Among these sectors a new prominent sector is healthcare. The healthcare environment is still information rich" but knowledge poor". There is a wealth of data available within the healthcare systems.

We propose a new and different approach to mine frequent patterns as discriminative features. It builds a Hierarchical structure that sorts or partitions the data onto nodes from the whole list. Then at each node, it directly discovers a discriminative pattern to further divide its examples into purer subsets that previously chosen patterns during the same run cannot separate. Since the number of examples towards leaf level is relatively small, the new approach is able to examine patterns with extremely low global support that could not be enumerated on the whole dataset by the batch method as given in Fig, So in this paper had combined data mining techniques with ACO for better heart disease prediction. In this paper we use data mining to emphasize to discover knowledge that is not only accurate, but also comprehensible for the users.

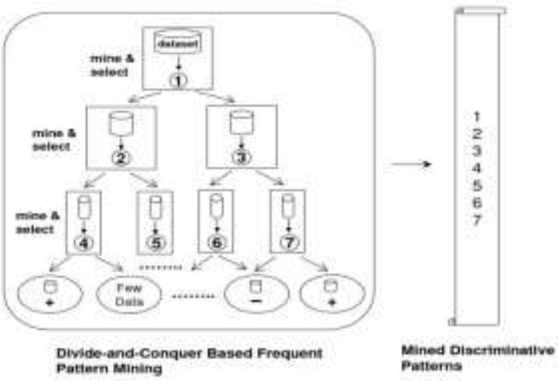


***Figure: 1 Mining Process***

This paper is being organized with overview of our proposed Technique. It is collectively explained here under the tiles arranged as follows: Introduction; Literature Review; describes about problem domain; proposed approach; result analysis; describes Conclusion.

## II. LITERATURE REVIEW

Since heart disease is something that cannot be detected by physical observation, but by analyzing different constraints that is associated with this disease. The diagnosis depends on the careful analysis of different clinical and pathological data of the patient by medical experts, which is a complicated process.

In 2016 Minal Zope, Sagar Birje, Lijo John, Amit Vasudevan , Nishant Salunkhe proposed an efficient algorithm hybrid with ANN (Artificial Neural Network) and K-mean technique approach for heart disease prediction. [36]

In 2016 M.Lavanya, Mrs.P.M.Gomathi, proposed the research which undertook an experience on application of varies data mining algorithm to predict the heart attacks and to compare the based method of prediction. The predictive accuracy determined by J48,REPTREE, naïve bayes, neural networks, CART.[35]

In 2014 Hlaudi Daniel Masethe, Mosima Anna Masethe proposed aresearch to build models for prediction of the class based on selected attributes. The research applies the following algorithms: J48, Bayes Net, and Naive Bayes, Simple Cart, and REPTREE algorithm to classify and develop a model to diagnose heart attacks in the patient data set from medical practitioners. [34]

In 2014 Dr. Durairaj.M, Sivagowry.S describes a preprocessing technique and analyzes the accuracy for prediction after preprocessing the noisy data. It is also observed that the accuracy has been increased to 91% after preprocessing. Swarm Intelligence techniques hybrided with Rough Set Algorithm are to be taken as future work for exact reduction of relevant features for prediction..[33]

In 2013 Sanjeev Kumar, Gursimranjeet Kaur proposed this paper is to detect the heart diseases in the person by using Fuzzy Expert System. The designed system based on the Parvati Devi hospital, Ranjit Avenue and EMC hospital Amritsar and International Lab data base. The system consists of 6 input fields and two output field. Input fields are chest pain type, cholesterol, maximum heart rate, blood pressure, blood sugar, old peak. The output field detects the presence of heart disease in the patient and precautions accordingly. It is integer valued from 0 (no presence) to 1 (distinguish presence (values 0.1 to 1.0). We can use the Mamdani inference method.[31]

In 2012 Nidhi Bhatla Kiran Jyoti proposed system has been developed with an aim to efficiently diagnose the presence of heart disease in an individual. Fuzzy logic has been used in Matlab for this development process [30].

In 2012, Peter, T.J. et al. [11] proposes use of pattern recognition and data mining techniques into risk prediction models in the clinical domain of cardiovascular medicine is proposed. The data is to be modelled and classified by using classification data mining technique.

In 2012, Muhammed et al. [12] present and discuss the experiment that was executed with naïve bayes technique in order to build predictive model as an artificial diagnose for heart disease based on data set which contains set of parameters that were measured for individuals previously.

In 2010, Srinivas, K. et al. [9] tell that Heart disease (HD) is a major cause of morbidity and mortality in the modern society. Medical diagnosis is extremely important but complicated task that should be performed accurately and efficiently. According to their study analyzes the Behavioral Risk Factor Surveillance System, survey to test whether self-reported cardiovascular disease rates are higher in Singareni coal mining regions in Andhra Pradesh state, India, compared to other regions after control for other risks. Dependent variables include self-reported measures of being diagnosed with cardiovascular disease (CVD) or with a specific form of CVD including (1) chest pain (2) stroke and (3) heart attack. According to the authors heart care study specifies 15 attributes to predict the morbidity. Beside regular attributes other general attributes BMI (Body Mass Index), physician supply, age, ethnicity, education, income, and others are used for prediction. An automated system for medical diagnosis would enhance medical care and reduce costs. They apply data mining techniques namely; Decision Trees, Naïve Bayes and Neural Network are used for prediction of heart disease.

In 2008, Palaniappan, Set al. [8] proposes about healthcare industry which collects huge amounts of healthcare data which, unfortunately, are not ";mined"; to discover hidden information for effective decision making. Discovery of hidden patterns and relationships often goes unexploited.

As given by Fayyad et al. [9] historically the notation of finding useful patterns in data have been given a variety of names including data mining, knowledge extraction, information discovery, information harvesting, data archaeology and data pattern processing but recently the terms data mining and KDD are dominating in the Management Information Science (MIS) communities and database fields.

Knowledge discovery or also known as data mining is the processes involve penetration into tremendous amount of data with the help from computer technology for analyzing the data. Data mining is a process of discovering interesting knowledge by extracting or mining from large amount of data and the process of finding correlations or patterns among dozens of fields in large relational databases. Association mining is one of the data mining tasks. The main task is to identify the relationship or correlation between items in dataset. Extensive surveys on the association mining and also frequent pattern mining have been conducted by [13] [14]. Almost a decade numbers of issues related to improve the capability of the algorithm including searching strategy, pruning techniques and data structure involved. The improvements are toward producing more meaningful rules by satisfying minimal support and also confidence constraint. There are also researches related to improvements of the algorithm to meet the domain needs

## III. PROBLEM DOMAIN

After studying several research papers we observe that there are lot of work in the area of heart diseases detection because 17.7 million people die each year from CVDs, an estimated 31% of all deaths worldwide. Since there already exists such system which can detect attack symptoms but in order to improve better attack detection decision tree Ant Colony Optimization (ACO) technique`s improved algorithm applied here. This approach aimed to optimize mining of dataset in comparison to existing one. This research is to the improvement in terms of Heart disease detection using ACO Technique.

## IV. PROPOSED METHODOLOGY

The Ant Colony Optimization (ACO) algorithm is a meta-heuristic that has a combination of distributed computation, autocatalysis (positive feedback), and constructive greediness to find an optimal solution for combinatorial optimization problems. This algorithm tries to mimic the ant's behaviour in the real world. Since its introduction, the ACO algorithm has received much attention and has been incorporated in many optimization problems, namely the network routing, traveling salesman, quadratic assignment, and resource allocation problems [13].

The ACO algorithm has been inspired by the experiments run by Goss et al. [14] using a colony of real ants. They observed that real ants were able to select the shortest path between their nest and food resource, in the existence of alternate paths between the two. The search is made possible by an indirect communication known as stigmergy amongst the ants. While traveling their way, ants deposit a chemical substance, called pheromone, on the ground. When they arrive at a decision point, they make a probabilistic choice, biased by the intensity of pheromone they smell. This behaviour has an autocatalytic effect because of the very fact that an ant choosing a path will increase the probability that the corresponding path will be chosen again by other ants in the future. When they return back, the probability of choosing the same path is higher (due to the increase of pheromone). New pheromone will be released on the chosen path, which makes it more attractive for future ants. Shortly, all ants will select the shortest path.

This behaviour was formulated as Ant System (AS) by Dorigo et al. [15]. Based on the AS algorithm, the Ant Colony Optimization (ACO) algorithm was proposed [18]. In ACO algorithm, the optimization problem is formulated as a graph $G = (C; L)$, where $C$ is the set of components of the problem, and $L$ is the set of possible connections or transitions among the elements of $C$. The solution is expressed in terms of feasible paths on the graph $G$, with respect to a set of given constraints. The population of agents (ants) collectively solves the problem under consideration using the graph representation. Though each ant is capable of finding a (probably poor) solution, good quality solutions can emerge as a result of collective interaction amongst ants. Pheromone trails encode a long-term memory about the whole ant search process. Its value depends on the problem representation and the optimization objective. A general outline of the ACO algorithm is presented below [15].

**Algorithm ACO meta heuristic();**

```
{
while (termination criterion not satisfied)
ant generation and activity();
pheromone evaporation();
daemon actions(); "optional"
end while
end Algorithm
}
```

In our proposed approach we took the data from Hnin Wint Khaing [10] for experimental study. The heart disease data set is shown in Table 1.

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***Tale 1: Heart Disease Data Set[10]***

| ID | Attribute |
|---|---|
| 1 | Age |
| 2 | Sex |
| 3 | painloc: chest pain location |
| 4 | Relrest |
| 5 | cp: chest pain type |
| 6 | trestbps: resting blood pressure |
| 7 | chol: serum cholesterol in mg/dl |
| 8 | Smoke |
| 9 | cigs (cigarettes per day) |
| 10 | years (number of years as a smoker) |
| 11 | fbs: (fasting blood sugar > 120 mg/dl) |
| 12 | dm (1 = history of diabetes; 0 = no such history) |
| 13 | famhist: family history of coronary artery disease |

The algorithm for the proposed concept in finding significant patterns for heart attack prediction is presented in this section. With the help of the database [10], the patterns significant to the heart attack prediction are extracted. The heart attack parameter with corresponding values and their weight is shown in table 2. This aim of our research is to apply the Ant Colony Optimization Algorithm and Association Rule Mining algorithm on patient symptoms for an efficient detection of Heart diseases. The Ant Colony Optimization (ACO) algorithm is a meta-heuristic that has a combination of distributed computation, autocatalysis (positive feedback), and constructive greediness to find an optimal solution for combinatorial optimization problems. This algorithm tries to mimic the ant's behaviour in the real world. Since its introduction, the ACO algorithm has received much attention and has been incorporated in many optimization problems, namely the network routing, travelling salesman, quadratic assignment, resource allocation problems and in efficient optimization.
The parameters under which dataset is being tested has been enlisted below in Table 2.

***Table 2: Heart Attack Parameters with Corresponding Values and Their Weight [10]***

| Parameter | Weight | Risk Level |
|---|---|---|
| Male and Female | Age<30<br>Age>30 | 0.1<br>0.8 |
| Smoking | Never<br>Past<br>Current | 0.1<br>0.3<br>0.6 |
| Overweight | Yes<br>No | 0.8<br>0.1 |
| Alcohol Intake | Never<br>Past<br>Current | 0.1<br>0.3<br>0.6 |
| High Salt Diet | Yes<br>No | 0.9<br>0.1 |
| High saturated diet | Yes<br>No | 0.9<br>0.1 |
| Exercise | Regular<br>Never | 0.1<br>0.6 |
| Sedentary Lifestyle/inactivity | Yes<br>No | 0.7<br>0.1 |
| Hereditary | Yes<br>No | 0.7<br>0.1 |
| Bad cholesterol | High | 0.8 |

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| | | |
|---|---|---|
| | Normal | 0.1 |
| Blood Pressure | Normal (130/89)<br>Low (< 119/79)<br>High (>200/160) | 0.1<br>0.8<br>0.9 |
| Blood sugar | High (>120&<400)<br>Normal (>90&<120)<br>Low ( <90) | 0.5<br>0.1<br>0.4 |
| Heart Rate | Low (< 60bpm)<br>Normal (60 to 100)<br>High (>100bpm) | 0.9<br>0.1<br>0.9 |

The proposed approach is shown in figure 2. In this approach we first accept the patterns that are actually the symptoms of the patient observed in 10-20 days of the observation period. Then we calculate the weight of the item set (symptoms) which are calculated by data mining algorithm. We apply association rule mining for calculating the frequency of the item set which is initially the pheromone value of the ants. The steps performed in association rule mining have been given here:

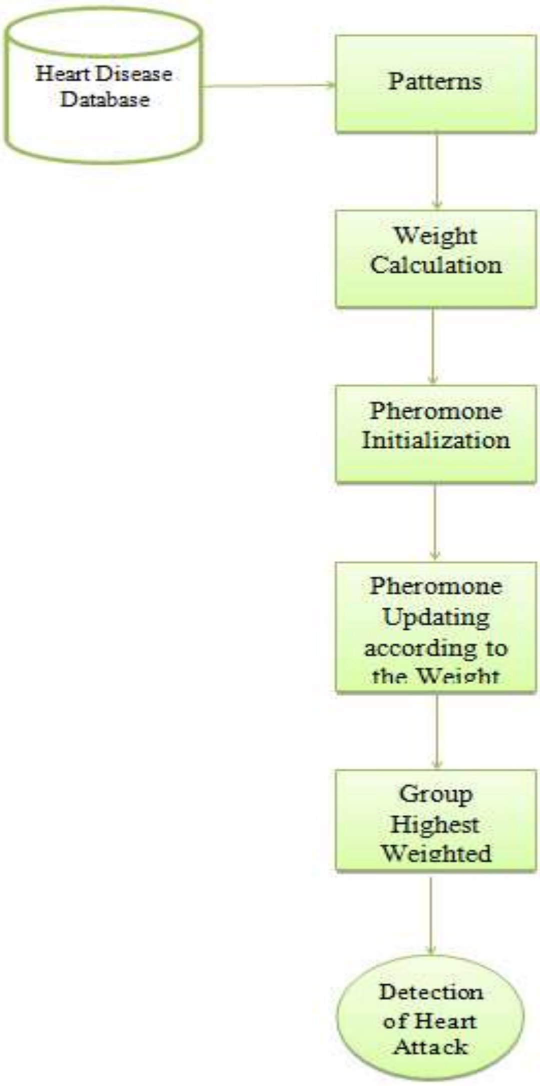


*Figure 2: Proposed Approach*

**Association Rule Mining**

```
C1 ¬ init-pass(T);
          F1 ¬ {f | f Î C1, f.count/n ³ minsup};    // n: no. of transactions in T
          for (k = 2; Fk-1 ¹ Æ; k++) do
                    Ck ¬ candidate-gen(Fk-1);
                    for each transaction t Î T do
                       for each candidate c Î Ck do
                              if c is contained in t then
                                c.count++;
                       end
                    end
               Fk ¬ {c Î Ck | c.count/n ³ minsup}
          end
return F ¬ Uk Fk;
```

Generating rules from frequent itemsets

- Frequent itemsets ¹ association rules
- One more step is needed to generate association rules
- For each frequent itemset X,
    - For each proper nonempty subset A of X,
    - Let B = X - A
    - A ® B is an association rule if
- Confidence(A ® B) ≥ minconf,
- support(A ® B) = support(AÈB) = support(X)
- confidence(A ® B) = support(A È B) / support(A)

By this we set the weight of the item set. Initially pheromone will be initialize, so it will be updated every time or in our case it will be updated for 10-20 iterations which is depend on the number of days the symptoms observed by the patient. Then we apply ant colony optimization algorithm.

The ants in ACO algorithm have the following properties [13]:

1. Each ant searches for a minimum cost feasible partial solution.
2. An ant *k* has a memory $M^k$ that it can use to store information on the path it followed so far. The stored information can be used to build feasible solutions, evaluate solutions and retrace the path backward.
3. An ant *k* can be assigned a start state $s^k_s$ and more than one termination conditions $e^k$.
4. Ants start from a start state and move to feasible neighbor states, building the solution in an incremental way. The procedure stops when at least one termination condition $e^k$ for ant *k* is satisfied.
5. An ant *k* located in node *i* can move to node *j* chosen in a feasible neighborhood $N^k_i$ through probabilistic decision rules. This can be formulated as follows:

An ant *k* in state $sr =< s_{r-1}; i >$ can move to any node *j* in its feasible neighborhood $N^k_i$ , defined as $N^k_i = \{j \mid (j \in Ni)\ \Lambda\ (< sr, j > \in S)\}\ sr \in S$, with *S* is a set of all states.

6. A probabilistic rule is a function of the following.

a) The values stored in a node local data structure Ai = [$a_{ij}$ ] called ant routing table obtained from pheromone trails and heuristic values,
b) The ant's own memory from previous iteration, and
c) The problem constraints.

7. When moving from node *i* to neighbour node *j*, the ant can update the pheromone trails $\tau_{ij}$ on the edge (*i*, *j*).
8. Once it has built a solution, an ant can retrace the same path backward, update the pheromone trails and die.

The trail intensity is determined by the below formula:

$$T_{ij}\ (t + n) = p\ .\ T_{ij}(t) + \Delta T_{ij}$$

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And the next move will be determine

$$\Delta T_{ij}^{k} = \begin{cases} \dfrac{Q}{L_k} & \text{if the kth ant uses edge}(i, j) \text{ in its tour} \\ & (\text{between time } t \text{ and } t+n) \\ 0 & \text{otherwise} \end{cases}$$

And then we concentrate on the group highest value and according to that value we predict the heart disease correctly or precisely says more accurate.

Then we find the precision and recall so that we achieve the accuracy.

For classification tasks, the terms true positives, true negatives, false positives, and false negatives compare the results of the classifier under test with trusted external judgments. The terms positive and negative refer to the classifier's prediction (sometimes known as the expectation), and the terms true and false refer to whether that prediction corresponds to the external judgment (sometimes known as the observation). This is illustrated by the table below:
Precision and recall are then defined as
Precision =TP/(TP +FP)
Recall=TP(TP + FN)

## V. RESULT ANALYSIS

The results of our experimental analysis in finding significant patterns for heart attack prediction are presented in the above section. With the help of the database, the patterns significant to the heart attack prediction are extracted using the approach discussed. The refined heart disease data set, resultant from preprocessing, is then clustered using K-means algorithm with K value. The frequent patterns are mined efficiently from the cluster relevant to heart disease, using the Association Rule Mining algorithm. After applying ACO several time, we receive the value as shown in figure 3(a) & (b).

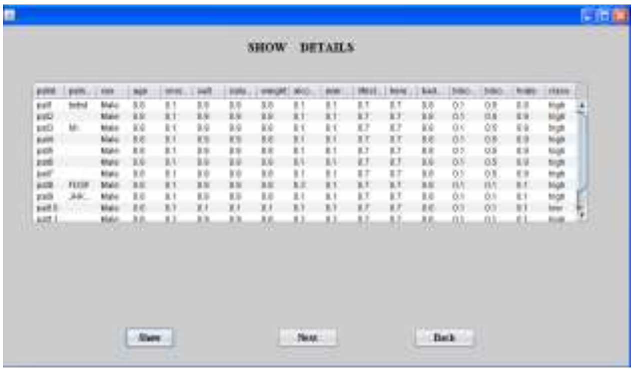


***Figure: 3(a) Heart disease cluster pattern***


***Figure: 3(b) ACO Result***

Based on the above grouping we received the final pheromone trails as shown in figure 4

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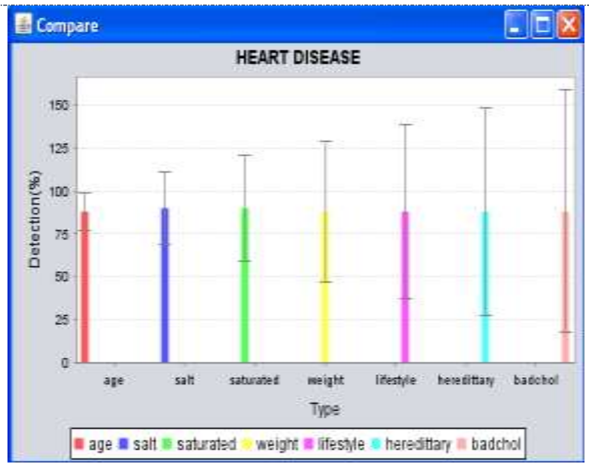


*Figure: 4 Final Pheromone Trails*

After applying different categorization as shown in the figure 3, we receive the continuous better accuracy in the case of increasing positive heart disease symptom. We provide the two best accuracy of our result which shows the betterment from the previous methodology adopted. The table 3 shows the accuracy. We also provide 4 different transactions and accuracy result by our approach in table 4.

*Table : 3 Accuracy Table*

| Technique | Accuracy |
|---|---|
| ACO and Data Mining | 91% |
| K-mean based MAFIA with ID3 | 85% |
| K-mean based MAFIA | 74% |

*Table 5.2 Accuracy Table of 4 Patients*

| patid | patname | group1 | group2 |
|---|---|---|---|
| pat2 | | 0 | 90.46 |
| pat3 | hh | 0 | 88.57 |
| pat8 | FDFS | 0 | 88.57 |
| pat14 | abc | 0 | 85.33 |

## VI. CONCLUSION

The use of data mining techniques in Heart Disease Detection increases the chance of making a correct and early detection, which could prove to be vital in combating the disease. We proposed an efficient concept for detection of Heart Diseases based on ant colony optimization and data mining. We use random ant generation for threshold setting and on the basis of that we find the global optimum value for each spectrum, so the detection is easy. Then we apply the transition probability for the next update of pheromone. Then the pheromone is reinitializing if it is needed. In future we apply the above phenomena for simulation to realize the results.

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