MEDICAL AID, HEALTHCARE ANALYSIS USING ANT COLONY ALGORITHM &NEURAL NETWORK

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Abstract—with the extensiveness of smart phones and the advance of Wireless Body Sensor Networks (WBSN), mobile Healthcare (m-Healthcare), which outspreads the process of Healthcare provider into a pervasive environment for improved health monitoring, has attracted considerable interest recently. However, the flourish of m-Healthcare still faces many challenges including medical assistance and the adequate emergency assistance. In this paper, we propose anemergency check and the quick medical aid providence to the patients along with a health analysis which would enhance the m-Healthcare in rural areas. By using a smart phone the Personal Health information (PHI) of the registered patients can be intensively collected. In the existing systems the medical observer should be stay active for all the time before the system gathering the PHI of the patient checking whether the whole biological parameters are in the normal condition. In this paper we propose an emergency detecting system by generating a pulse in case of any emergency. A Swarm based algorithm (Ant Colony Algorithm) is implemented to calculate the shortest path from the hospital to the patient whenever the emergency is being detected.Also by using the Spike neural network a health analysis of the patient is being done by considering the past few data.

Keywords—Mobile-Healthcare emergency; Personal Health Information; Ant colony algorithm; Wireless Body sensor networks;Spike Neural network

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INTRODUCTION

The challenges in the hierarchy of detecting the relevant quantities, monitoring and collecting the data, assessing and evaluating the information, formulating meaningful user displays, and performing decision-making and alarm functions are enormous. The information needed by smart environments is provided by Wireless Sensor Networks, which are responsible for sensing as well as for the first stages of the processing hierarchy.

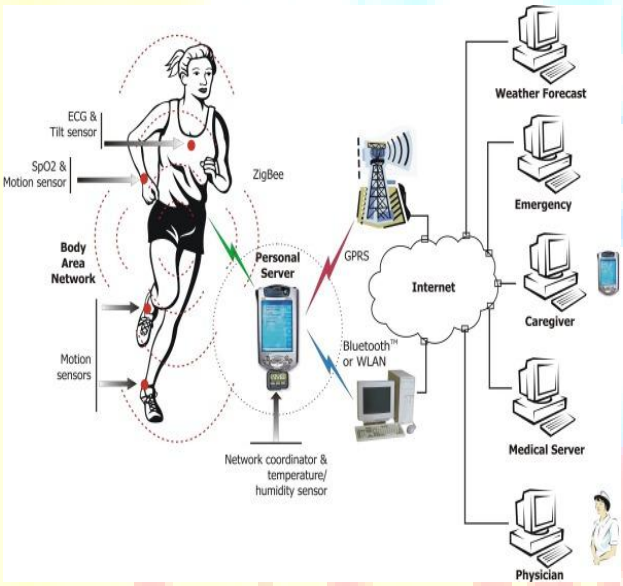

Fig.1: m-healthcare using WSN

The main purpose of a WSN is to provide users with access to the information of interest from data collected by spatially distributed sensors. In real-world applications, sensors are often deployed in high numbers to ensure a full exposure of the monitored physical environment. Consequently, such networks

are expected to generate enormous amount of data. The desire to locate and obtain information makes the success of WSNs applications, largely, determined by the quality of the extracted information

By using the wireless body sensors the biological parameters values are sensed and these values are transmitted to the medical center via smartphone. For the time being, in this implementation we had collected the physical information of patients from various hospitals and are kept as a database for the further processing. The data transmission from the smartphone to the medical center is done by using APACHE (Goldfish).The programming is done in Android platform. Android is an operating system based on Linux with a Java programming interface. The Android Software Development Kit (Android SDK) provides all necessary tools to develop Android applications. This includes a compiler, debugger and a device emulator, as well as its own virtual machine to run Android programs.For providing hospital to hospital transmission the J2EE technology is used.

The remainder of this paper is organized as follows: Section 1 reviews related work in the field. Section2 gives the details about the Spike Neural Network and section 3 describes about the emergency detection. Section 4 detailsthe basics of Ant colony algorithm. Section 5 includes the design techniques for all the techniques and analyzesits implementation.Section 6 contains the simulation results of our work and Section 7 concludes our work.

I . RELATED WORK

GENETIC ALGORITHM

In the computer science field of artificial intelligence, a genetic algorithm (GA) is a search heuristic that mimics the process of natural evolution. Genetic algorithms belong to the larger class of evolutionary algorithms (EA), which generate solutions to optimization problems using techniques inspired by natural evolution, such as inheritance, mutation, selection, and crossover.In a genetic algorithm, a population of candidate solutions (called individuals, creatures, or phenotypes) to an optimization problem is evolved toward better solutions. Each candidate solution has a set of properties (its chromosomes or genotype) which can be mutated and altered; traditionally, solutions are represented in binary as strings of 0s and 1s, but other encodings are also possible.

Once the genetic representation and the fitness function are defined, a GA proceeds to initialize a population of solutions and then to improve it through repetitive application of the mutation, crossover, inversion and selection operators.

II NEURAL NETWORK

An Artificial Neural Network (ANN) is an information processing paradigm that is inspired by the way biological nervous systems, such as the brain, process information. The key element of this paradigm is the novel structure of the information processing system. It is composed of a large number of highly interconnected processing elements (neurons) working in unison to solve specific problems. ANNs, like people, learn by example. An ANN is configured for a specific application, such as pattern recognition or data classification, through a learning process.

By using the neural network the health analysis is being done. For this we have taken the personal health data of the patients for 7 days. By simulating this data using the neural network the health graph of the patients are created. By using this graph we can determine the condition of the patient; whether it is getting improved or not.

The health data are compared with the normal values and the error is calculated. By evaluating the error we can determine the condition of the patient.

III EMERGENCY DETECTION

The existing systems had a drawback that the medical observer should always present before the system continuously monitoring the patient.Inorder to overcome that we have set a pulse generating system whenever the system founds a patient to be in an emergency condition. The threshold values are set for each biological parameter. The patient's data are updated and is compared with the normal values. Whenever the updated data gets exceeds the threshold limit set a pulse is generated indicating the medical observer that the particular patient is in abnormal.

IV SHORTEST PATH CALCULATION

The shortest path calculation founds to be more important for providing a quick and sudden emergency assistance to the patients at their critical condition. By finding the shortest path to the patient from the medical center, the ambulance facilities and the first aid can be given to the patient whenever it is necessary.

In this paper, we implement the ant colony algorithm inspired by the behavior of ants during searching/finding paths from the nest to food sources.

Ants are able to find the shortest path between a food source and the nest without the aid of visual information, and also to adapt to a changing environment. It was found that the way antscommunicate with each other is based on pheromone trails. While ants move, they drop a certain amount of pheromone on the floor, leaving behind a trail of this substance that can be followed by other ants. The more ants follow a pheromone trail, the more attractive the trail becomes to be followed in the near future.

The Ant Colony Algorithm goes along with the Travelling Salesman Problem. So the study of Travelling Salesman problem is inevitable in our analysis. For this we can consider the ants as simple agents that travels from one city to the other. Given a set of cities and the distance between each possible pair, the travelling salesman problem can be used to find the best possible way of visiting all the cities precisely once and returning to the starting point.

As presaid the ants can be considered as travelling from one city to another. During their travel the pheromone deposition occurs.Each edge has some pheromone quantity associated with it.The pheromone quantities change dynamically with the ants' motion in the graph. An ant decides to take an edge depending upon the edge length and the pheromone quantity. The pheromone in each edge is decreased by a constant factor with time.

V. DESIGN TECHNIQUES

NEURAL NETWORK

For the health analysis the training method used is the Back propagation. Itis a common method of training artificial neural networks. From a desired output, the network learns from many inputs. It is a supervised learning method, and is a generalization of the delta rule. It requires a dataset of the desired output for many inputs, making up the training set. It is most useful for feed-forward networks. Back propagation requires that the activation function used by the artificial neurons (or "nodes") bedifferentiable.

The artificial neural network consists of mainly three layers: Input layer, hidden layer and output layer. The hidden layer and the output layer have sigmoidal function as their output.

$$OH = \frac{1}{(1 + \exp(-slope * (IH - th)))} \quad \text{----------} \rightarrow (1)$$

Where 'OH' is the output of the hidden layer, 'IH' is the input of the hidden layer and 'th' is the threshold.

$$OO = \frac{1}{(1 + \exp(-slope * (IO - th)))} \quad \text{----------} \rightarrow (2)$$

Where 'OO' is the output of the hidden layer, 'IO' is the input of the hidden layer and 'th' is the threshold.

The weight is assigned for the layers. On each iteration the weights are updated. The error is being calculated by finding the difference between the Target values (T) and the output of the output layer (OO).

$$error, E = T - OO \quad \text{----------} \rightarrow (3)$$

By using these equations the error is being calculated and the graph for that is plotted from which we can understand the health condition of the patient.

ANT COLONY ALGORITHM

The Ant colony Algorithm steps are being explained as below:

- Initialize the pheromones for all the connections between the cities.
- Send out a wave of ants.
- For each ant
  * start the ant in a random city
    * choose the next city by using a probability equation based on the pheromone strength and distance to the next city
    * visit all the cities to construct a path
    * optimize the path
    * combine the pheromones for this route with the Pheromones released from the other ants in this wave.
- Update the pheromone levels.
- Repeat the entire process until there are no changes in the best path for 'X' iterations

In this paper whenever an emergency is detected in any rural area first we have to locate the nearest city by using the Ant Colony Algorithm. After locating the nearest city, the multi-specialtyhospitals in that city have to be listed out. Then the information about the patient and the patient's location are transmitted to that hospital by means of a smartphone.

Consider that the ants move from one city 'k' to another city 'i.'

For the algorithm to start the value of pheromone to be set initially. The initial pheromone value is calculated by

$$initial\ pheromone = 1/average\ distance\ between\ the\ points$$

--------- →(4)

The mathematical formation for the pheromone updating is given by

$$Ph_{(new)=}(1-\mathrm{p})\left(Ph_{(k\,to\,i)}\right)+\sum Ph_{(k\,to\,i)} \text{---------} \rightarrow (5)$$

Where,

'$Ph_{(new)}$ 'is the updated pheromone. 'ρ ' is the decay constant that determines how fast scents from old routes dissipate.$Ph_{(\_k\,to\,i)}$ is the pheromone trail from the point 'k' to 'i'.ε $Ph_{(k\,to\,i)}$ is the sum of pheromones from 'k' to 'i' from most recent waves.

The Travelling Salesman problem is similar to the ACO.

Set the parameters

Initialize the pheromone trials

While (termination condition not met)

Do

Construct solutions

Update trials

end

As said before the ants store the details of their recently visited cities in their memory which is termed as Tabulist. This is a short term memory list which helps the ants to prevent the revisiting of the cities.

The algorithm for Tabu search and thereby finding the optimal solution is being given as below.

- Select a random solution
- Create an empty Tabu list
- Check for the optimal solutions until the fitness score or the timing threshold is achieved
- Check whether the optimal solutions contain any Tabu elements

- If not add the solution to the Tabu list
- The ultimate solution is the one which have the greatest fitness score
- When the Tabu list is full it is emptied in the order of their entry into the Tabu list.

The below given is the Canonical Ant Colony Algorithm.

- In this three constants are being used.ie α, β and ρ .
- α and β are two positive real parameters whose values
- determine the relative importance of pheromone versus heuristic information
- $\alpha \geq 0 ; \beta \geq 0 ; 0 \leq \rho \geq 1;$
- The values of α ranges from (0 - 5)
- β ranges from (0 - 20)
- ρ ranges from (0.1 to 0.9)

$$p_{ij} = \frac{(\tau_{ij0})^{\alpha} (\eta_{ij})^{\beta}}{\sum_{i=1}^{N_i} (\tau_{ij0})^{\alpha} (\eta_{ij})^{\beta}} \text{ ----------} \rightarrow (6)$$

for t = 1 to T {

for k = 1 to M {

evaluate ant k

if ant k better than best ant k

best ant = ant k

$\Delta \Pi_{ijt}$ – fitness of ant k if using assignment 'ij'

otherwise 0

}

$$\Delta \Pi_{ijt} = \rho \Pi_{ijt-1} + \sum_{k=1}^{m} \Delta \tau_{ijt} \text{ ----------} \rightarrow (7)$$

for k = 1 to m {

construct new ant k using P_{ij}

$$p_{ij} = \frac{(\tau_{ijt})^{\alpha}(\eta_{ij})^{\beta}}{\sum_{i=1}^{N_i}(\tau_{ijt})^{\alpha}(\eta_{ij})^{\beta}}$$

----------→ (8)

}

}

return best ant

m = number of ants in population

T = number of iterations (generations)

ij = portion of entire solution (trail)

N_i = neighborhoods of location *i*

$Л_{ijt}$= amount of pheromone on trail *ij* at time *t*

$\Delta Л_{ijt}$= addition of pheromone on trail *ij* at time *t*

ρ = evaporation factor ($0 < \rho < 1$)

α = relative importance of pheromone

β = relative importance of heuristic

VI SIMULATION RESULT

The health information from the patient is transmitted by using a smartphone to the medical center by using the Android 2.2 operating system. The Reporter as shown in figure.3 shows the patient's health information. By using this reporter manual as well as sensed data can be uploaded to the smartphoneThe above obtained data from the sensors are integrated together for transmitting to the medical Centre. For the time being we have collected the data from the hospitals and is kept as a data sheet.

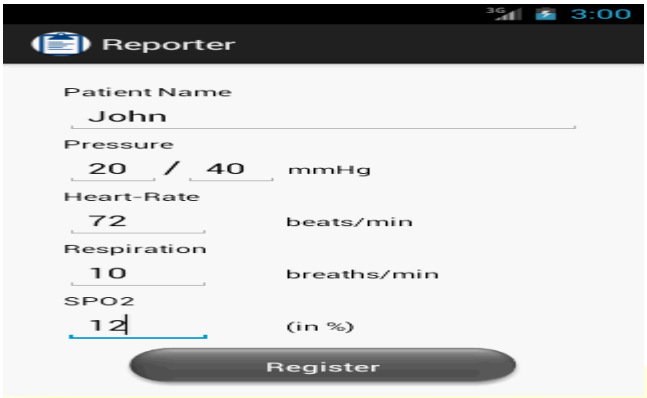

Fig .2: Patients' Health Reporter

Fig.2 shows the data of patient in a smartphone. This data can be entered manually or it can be sensed by the body sensors.

```
INFO: RegistrationForm was successfully deployed in 4,729 millisecond
INFO: Loading application RegistrationForm at /RegistrationForm
INFO: RegistrationForm was successfully deployed in 698 milliseconds.
INFO: Loading application RegistrationForm at /RegistrationForm
INFO: RegistrationForm was successfully deployed in 448 milliseconds.
INFO: Loading application RegistrationForm at /RegistrationForm
INFO: RegistrationForm was successfully deployed in 677 milliseconds.
INFO: Loading application RegistrationForm at /RegistrationForm
INFO: RegistrationForm was successfully deployed in 702 milliseconds.
INFO: Patient Name:John
INFO: ------------------
INFO: > Pressure : 20/40 mmHg
INFO: > Heart Beat : 72 beats/min
INFO: > Respiration : 10 breaths/min
INFO: > SPO2 : 12 %
```

Fig.3: Data integration in smartphone

```
[INFO: RegistrationForm was successfully deployed in 4,729 millisecon
[INFO: Loading application RegistrationForm at /RegistrationForm
[INFO: RegistrationForm was successfully deployed in 698 milliseconds
[INFO: Loading application RegistrationForm at /RegistrationForm
[INFO: RegistrationForm was successfully deployed in 448 milliseconds
[INFO: Loading application RegistrationForm at /RegistrationForm
[INFO: RegistrationForm was successfully deployed in 677 milliseconds
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[INFO: RegistrationForm was successfully deployed in 702 milliseconds
[INFO: Patient Name:John
[INFO: ------------------
[INFO: > Pressure : 20/40 mmHg
[INFO: > Heart Beat : 72 beats/min
[INFO: > Respiration : 10 breaths/min
[INFO: > SPO2 : 12 %
```

Fig.4: Data received at the medical center (server)

As shown in Fig.3the health information are integrated together and is sent to the medical center. The health analysis is being done by considering the data of 7 days. The number of hidden layers used is 12 and the number of epochs is 5.

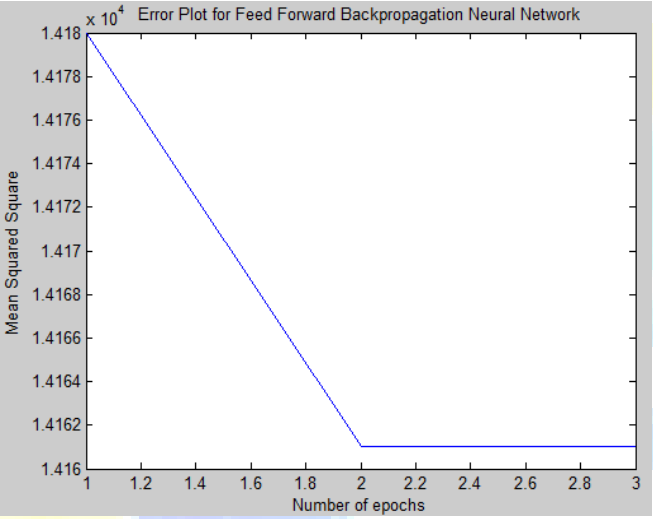

Fig.5: Plot for pressure analysis

Likewise the other parameters can also be analyzed.

Whenever the updated value exceeds the threshold level a pulse will get generated. The emergency is being detected by the generation of a pulse which is shown in Fig.6

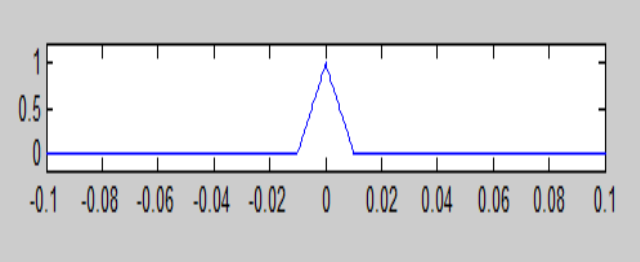

Fig.6: Pulse generation in the case of emergency

Whenever the emergency is detected the shortest path has to be calculated using Ant colony algorithm. Here for our simulation we have considered only 5 cities. So as per the algorithm the number of ants will also be 5.At initial state all the ants are randomly placed in any of the 5 cities. We have found the results for the best tour length, Tour of all the 5 ants in 5 cities and also the best path. The best shortest path is obtained and is plotted.

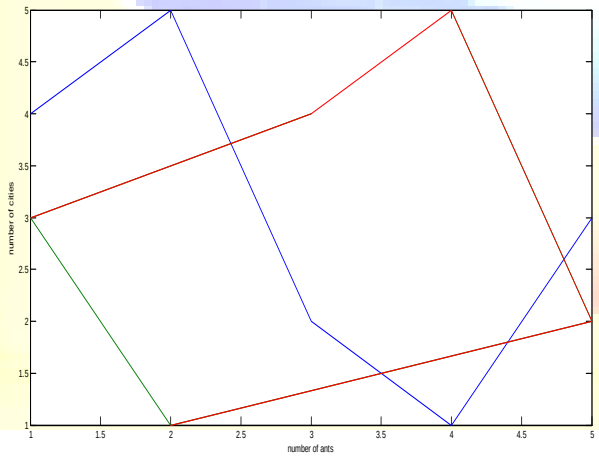

Fig.7: Tour of all ants

Fig.7 shows the tours made by all the ants in all the possible ways. The best of all these paths is taken as the shortest path

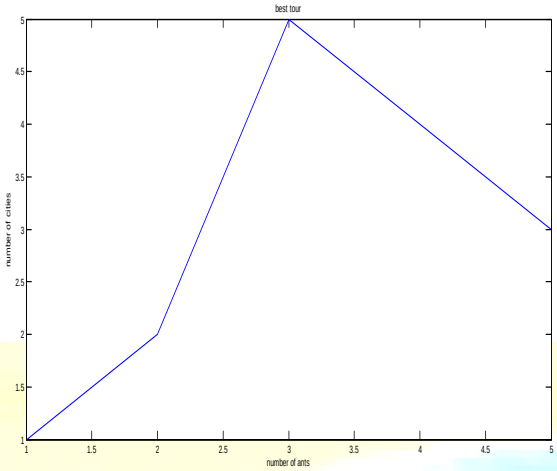

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Fig.8: Plot of Best Tour

The Fig.8 explains the best tour of all the ants in the whole tours. The best tour is taken as the shortest path of all the paths.

The above shown are the simulation results of our paper. Theresult shows that the above described techniques could beat the challenges that are faced by the mobile healthcare field.

VII CONCLUSION

In this paper, we have implemented the health information transfer by using a smartphone. For this the Android programming and the Java Net Beans have been studied. The Spike Neural helps us to provide a continuous heath checker which determines the condition of the patient. The MATLAB coding is being done to detect the emergency. Ant Colony Algorithm for enhancing the m-Healthcare emergency which delivers an extremely resourceful technique for computing the shortest path has also been implemented in MATLAB. By calculating the shortest path from the medical center to the patient we can provide an adequate medicalassistance to the patients whenever it is necessary. Detailed analysis of all these

a technique shows that all these methods are very effective lifesaving method which will be an innovative step in the mobile healthcare field.

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